S. HRG. 115–644

ADVANCING THE INTERNET OF THINGS IN RURAL AMERICA

HEARING

BEFORE THE

SUBCOMMITTEE ON COMMUNICATIONS, TECHNOLOGY, INNOVATION, AND THE INTERNET

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

NOVEMBER 7, 2017

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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ADVANCING THE INTERNET OF THINGS IN RURAL AMERICA

TUESDAY, NOVEMBER 7, 2017

U.S. SENATE,
SUBCOMMITTEE ON COMMUNICATIONS, TECHNOLOGY,
INNOVATION, AND THE INTERNET,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10 a.m. in room SR–253, Russell Senate Office Building, Hon. Roger Wicker, Chairman of the Subcommittee, presiding.

Present: Senators Wicker [presiding], Blunt, Fischer, Moran, Capito, Gardner, Schatz, Cantwell, Klobuchar, Blumenthal, Markey, Udall, Duckworth, Hassan, and Cortez Masto.

OPENING STATEMENT OF HON. ROGER F. WICKER, U.S. SENATOR FROM MISSISSIPPI

Senator WICKER. Good morning. Thank you all for being here. Today, the Subcommittee meets to examine the Internet of Things. Our discussion will focus on how to advance the availability and accessibility of these technologies in rural America. I'm glad to convene this hearing with my good friend and colleague, Ranking Member Schatz.

The Internet of Things encompasses a diverse market of Internet-connected devices, machines, and physical objects. Over the past few years, we've seen an increasing number of physical objects like refrigerators and washing machines take on smarter capabilities through Internet-connected sensors. Internet connectivity enables these things to collect data and share actionable insights to consumers and businesses alike. This information allows the user to be more productive, efficient, and cost effective. It's changing our economy.

Beyond generating simple conveniences, IoT technologies are taking on more significant and vital roles in our lives. They are making us safer, improving our health, and opening up opportunities for economic advancement in both urban and rural communities. In our rural communities, in particular, IoT technologies, such as telemedicine, are making a big impact.

In my home state, the University of Mississippi Medical Center, which is represented here today, is providing lifesaving healthcare services through innovative telehealth applications. Physicians are remotely monitoring and diagnosing patients. This remote access can offer specialty care that is not readily available in many rural communities.

Our first responders are also using telemedicine to communicate and provide treatment in the field. For example, first responders can consult with emergency personnel in hospitals through video applications. This is accelerating the delivery of care and saving lives.

Underlying these IoT technologies and their economic and societal benefits are reliable broadband connections and mobile broadband services. Internet connectivity is absolutely essential to the adoption of these technologies. As IoT technologies become smarter and increasingly sophisticated, they will require seamless and reliable Internet connectivity to achieve the promised health, safety, and economic benefits.

To that end, it is vitally important that the Federal Communications Commission take steps to ensure that the Universal Service Fund program provides adequate and predictable support to help preserve and expand broadband in rural and underserved communities. It's also important for the Commission to collect accurate and reliable coverage data for programs, like Phase II of the Mobility Fund, before making new funding decisions. We should ensure the delivery of essential communication services to communities in need first.

In addition to accelerating the deployment of broadband in our rural areas, cybersecurity will be key to advancing the economic success of the Internet of Things market. Large scale data breaches have understandably shaken consumers' confidence and trust. Fortified security measures will help strengthen the United States leadership role and competitiveness in the IoT market around the world. The Internet of Things marks an exciting space for digital innovation in this country. There is significant economic potential associated with these technological developments.

Today, I look forward to learning from our witnesses about how the IoT is bringing vital services to rural America and creating opportunities for investment, innovation, and job creation. I welcome the testimony of the witnesses here today and thank them for their testimony.

At this point, I will recognize my colleague, the Ranking Member of this Subcommittee, Senator Schatz.

STATEMENT OF HON. BRIAN SCHATZ,
U.S. SENATOR FROM HAWAII

Senator SCHATZ. Thank you very much, Chairman Wicker.

IoT brings great opportunity for everyone, regardless of their zip code. For instance, in Hawaii, we've already seen IoT technologies improve access to healthcare in rural communities. A few months ago, I visited the Island of Lanai and met the staff at the Lanai Community Health Center, who told me that they've been using telehealth in their practice for a few years now. Through IoT technologies, they're helping patients to manage diabetes remotely and connecting patients with specialists on Oahu.

This has resulted in higher quality care with improved diagnoses and medication management and also substantial savings in travel costs. We should be making it easier for organizations like the Lanai Community Health Center to cut costs and improve care

with these technologies. It is my hope that our Federal laws will enable patients and providers in every state to use telehealth.

In this effort, I introduced the Connect for Health Act with Chairman Wicker, Chairman Thune, Ranking Member Nelson, and others on this committee, including Senators Capito, Klobuchar, and Blunt. This bill lifts outdated restrictions on originating sites and geographic requirements and does so in ways that can better control costs for Medicare. Four provisions from the Connect for Health Act were included in the Chronic Care Act which passed the Senate and is being considered by the House.

Telehealth is just one example of how rural communities across America can benefit from IoT. But this can only happen if they have the right infrastructure and resources. Right now, not everybody is able to take advantage of IoT for many reasons, but I'll list just three.

First, there is a broadband gap. IoT in rural areas cannot fully take off without broadband connectivity. Some telehealth applications can succeed without full broadband access, and we should push ahead with those, but there are others the require the broadband. Unfortunately, one in four rural residences still does not have access to 25 megabits per second broadband.

To close this gap, we need more accurate information to start. Right now, there are a number of issues with the way the FCC collects information on where broadband is and is not available. This needs to change. Senator Manchin's Rural Wireless Access Act takes a step in the right direction by asking the FCC to establish a consistent methodology for data collection. We need to know where the divide is, so we are taking steps to close it.

Second, there is the cost of the physical infrastructure. Congress has a role to play in getting that infrastructure deployed. This can include public-private partnerships and tax credits. But it will take direct spending to get broadband built out where the private sector won't.

Third, there is a gap in adoption. Naturally, much of our focus is on expanding availability, but we cannot lose sight of gaps in actual adoption of broadband. There are a number of reasons for the lack of adoption, including pricing, digital literacy, and other issues. Rural consumers' adoption of broadband will be essential for realizing the full potential of IoT.

After this hearing, I look forward to working with Chairman Wicker and others on the Committee on some direct steps that can be made, removing barriers for broadband deployment and promoting innovations in unlicensed spectrum.

Thank you again, Chairman Wicker, for holding this hearing.

Senator WICKER. Thank you.

Senator Schatz has a commitment at another committee, and we hope that you can be back shortly. We certainly appreciate the fact that you're spread mighty thin this morning.

Our witnesses today are Mr. Michael Adcock, Executive Director, Telehealth Center, at the University of Mississippi Medical Center; Mr. David Armitage, Founder and CEO of Cartasite; Mr. Timothy Hassinger, President and CEO of Lindsay Corporation; Mr. Michael Terzich, Chief Administrative Officer of Zebra Technologies; and

Ms. Angela Siefer, Director, National Digital Inclusion Alliance. We are thrilled to have all of these witnesses here.

Mr. Adcock, you're recognized first for a summary of your testimony for approximately 5 minutes. Welcome.

STATEMENT OF MICHAEL P. ADCOCK, FACHE, EXECUTIVE DIRECTOR, CENTER FOR TELEHEALTH, UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

Mr. ADCOCK. Chairman Wicker, Ranking Member Schatz, and members of the Subcommittee, thank you for the opportunity to appear here today. I am Michael Adcock, Executive Director for the Center for Telehealth at the University of Mississippi Medical Center in Jackson, Mississippi. I am honored to talk with you this morning about telehealth and the ways that its power can be harnessed to address healthcare needs across America.

Telehealth has been a part of the healthcare landscape in Mississippi for over 14 years, beginning with an aggressive program to address mortality in rural emergency departments. Today, the UMMC Center for Telehealth delivers more than 30 medical specialties across 200 sites of service across the state, including rural clinics, schools, prisons, and corporations. This network allows us to deliver world class care in 68 of Mississippi's 82 counties and provide access for patients who might otherwise go untreated.

Over the last decade, we have conducted over 500,000 patient encounters through telehealth. Maximizing our utilization of healthcare resources through the use of technology is the only way we can reach all of the Mississippians who need lifesaving healthcare and would not be available in local communities and homes without broadband connectivity.

One program that has been very impactful for our patients is remote patient monitoring, which manages chronic disease in patients' homes. Our initial pilot with diabetes in the Mississippi Delta was a public-private partnership between critical access hospital North Sunflower Medical Center, telecommunications provider C Spire, technology partner Care Innovations, the Mississippi Division of Medicaid, the Office of the Governor of Mississippi, and the University of Mississippi Medical Center.

The results of the study showed a marked decrease in blood glucose, early recognition of diabetes-related eye disease, reduced travel to see specialists, and no diabetes-related hospitalizations or emergency room visits among our patients. This pilot demonstrated impressive savings, and the Mississippi Division of Medicaid extrapolated the financial data to show potential savings of over $180 million per year if 20 percent of the diabetics on the Mississippi Medicaid program participated. This pilot demonstrated how educating patients about their disease and empowering them to care for themselves is extremely beneficial and is best done in their home.

Initially, wired broadband in the home was thought to be the easiest way to provide the connectivity needed. But because only one third of Mississippians have access to residential fixed broadband, this is not always a reliable option. To provide the most reliable connectivity, we partnered with C Spire, a regional telecommunications company, to connect our patients via mobile

broadband. This worked during the pilot program and continues to be our solution for connecting patients to the resources they need for remote patient monitoring. However, as telehealth grows and additional services are available, a more reliable fixed solution will be necessary.

While our center continues to find ways to connect patients to the care they need, too many Americans still lack access to broadband. Ten percent of all Americans and 39 percent of rural Americans lack access to adequate service. In Mississippi, the digital divide is even more pronounced. In our state, only 34 percent of Mississippians have access to residential fixed broadband connections.

Two-thirds of Mississippi counties are more than a 40-minute drive from specialty care. In order to deliver care in an efficient manner across our state, expansion of reliable and available broadband is essential. The Center for Telehealth has worked closely with local and national telecommunications providers to expand band width in sites across Mississippi. These partnerships, along with investments from FCC's Universal Service Fund program, have made broadband more available and more affordable in many regions of our state.

More can and should be done. Legislation introduced by Chairman Wicker would improve the validity and reliability of wireless coverage and expand broadband to rural areas and communities that are truly in need. The Rural Wireless Act and SPEED Act of 2017 will help close the digital divide experienced by many, especially in rural and remote geographic areas where disease burden is greatest. It will do this by eliminating delays that often raise cost and slow the deployment of broadband to rural areas. It will also fast-track the deployment of next-generation broadband that is critical to advancing innovative technologies.

The benefits of telehealth are not available to patients without access to high-speed Internet. As technology and healthcare services expand to meet patients where they live, broadband coverage must improve to make this care accessible.

Thank you for taking the time to focus on how access to broadband in rural areas can help to close the digital divide, bring healthcare resources to remote communities, and create a connectedness that transcends location. Without broadband, healthcare cannot operate outside of America's hospitals and clinics and cannot harness the power of technology to better treat our patients.

Thank you for inviting me to testify today and for your time and attention to this very important matter.

[The prepared statement of Mr. Adcock follows:]

PREPARED STATEMENT OF MICHAEL P. ADCOCK, FACHE, EXECUTIVE DIRECTOR, CENTER FOR TELEHEALTH, UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

Chairman Wicker, Ranking Member Schatz, and Members of the Committee, thank you for the opportunity to appear before you today. I am Michael Adcock, Executive Director for the Center for Telehealth at the University of Mississippi Medical Center (UMMC) in Jackson, Mississippi. I am honored to talk to you this morning about telehealth and the ways that its power can be harnessed to address healthcare needs across America.

Mississippi has significant healthcare challenges, leading the Nation in heart disease, obesity, cardiovascular disease and diabetes. These and other chronic conditions require consistent, quality care—a task that is made harder by the rural na-

ture of our state. In order to improve access to care and give Mississippians a better quality of life, it is clear that we need something more than traditional, clinic and hospital-based services.

Telehealth has been a part of the healthcare landscape in Mississippi for over 14 years, beginning with an aggressive program to address mortality in rural emergency departments. In 2003, three rural sites were chosen to participate in a program that would allow UMMC board certified emergency medicine physicians to interact with and care for patients in small, rural emergency rooms via a live, audio-video connection. The TelEmergency program has grown to serve more than 20 hospitals and continues to produce outcomes on par with that of our Level 1 trauma center.

Today, the UMMC Center for Telehealth delivers more than 30 medical specialties in over 200 sites across the state including rural clinics, schools, prisons and corporations. The depth and breadth of this network allows us to deliver world-class care in 68 of our state's 82 counties and provide access for patients who might otherwise go untreated. Over the last decade, we have conducted over 500,000 patient encounters through telehealth. Maximizing our utilization of healthcare resources through the use of technology is the only way we can reach all of the Mississippians who need lifesaving health care. These world class services would not be available in local communities and homes without broadband connectivity.

One program that has been very impactful for our patients is remote patient monitoring (RPM), which manages chronic disease in a patient's home. RPM is designed to educate, engage and empower patients so that they can learn to take care of themselves. Our initial pilot with diabetics in the Mississippi Delta was a public/private partnership between critical access hospital North Sunflower Medical Center, telecommunications provider C Spire, technology partner Care Innovations, the Mississippi Division of Medicaid, Office of the Governor of Mississippi and UMMC. The purpose of the pilot was to test the effectiveness of remote patient monitoring using technology in a rural, underserved area. The results of the study showed a marked decrease in blood glucose, early recognition of diabetes-related eye disease, reduced travel to see specialists and no diabetes-related hospitalizations or emergency room visits among our patients. This pilot demonstrated a savings of over $300,000 in the first 100 patients over six months. The Mississippi Division of Medicaid extrapolated this data to show potential savings of over $180 million per year if 20 percent of the diabetics on Mississippi Medicaid participated in this program. The benefits were not only financial and health related. Many of the patients who participated in this program did not have Internet connectivity in their homes and some had never accessed the internet. This program opened up a whole new world to them and has sparked their interest in staying connected.

The pilot demonstrated how educating patients about their disease and empowering them to care for themselves is extremely beneficial and is best done in their home. Bringing this technology into the home requires access to reliable broadband coverage. Initially, wired broadband in the home was thought to be the easiest way to provide the connectivity needed, but because only one third of Mississippians have access to residential fixed broadband, this is not always a reliable option. To provide the most reliable connectivity, we partnered with C Spire, a regional telecommunications company, to connect to our patients via mobile broadband. This worked during the pilot program and continues to be our go to solution for connecting patients to the resources they need for remote patient monitoring. However, as telehealth grows and additional services are available in the home, a more reliable, fixed solution will be necessary.

Given the success of the pilot, UMMC Center for Telehealth has expanded remote patient monitoring to include adult and pediatric diabetes, congestive heart failure, hypertension, bone marrow transplant and kidney transplant patients. Working closely with a patient's primary care provider, we continue to grow this program both in terms of volume and number of diseases that can be managed. It gives patients the knowledge and tools they need to improve their health and manage their chronic disease.

While our Center continues to find ways to connect patients to the care they need, too many Americans still lack access to broadband, particularly the 23 million Americans living in rural areas. Ten percent of all Americans (34 million people) and 39 percent of rural Americans lack access to 25 Mbps/3 Mbps service. FCC data shows that as many as one in three households do not subscribe to Internet service. In Mississippi the digital divide is even more pronounced. In our state, only 34 percent of Mississippians have access to residential fixed broadband connections, with only three counties showing greater than 60 percent residential broadband access.

Mississippi spans 48,000 square miles, two thirds of our counties are more than a 40 minute drive from specialty care. When people live that far from specialty care,

at best, care is delayed. At worst, care is never received. Telehealth allows us to deliver care in areas where it would not normally be available. In order to deliver care in an efficient manner across our state, expansion of reliable and available broadband is essential. The Center for Telehealth has worked closely with local and national telecommunications providers to expand bandwidth in sites across Mississippi. These partnerships, along with investment from the FCC's Universal Service Fund program, have made broadband more available and affordable in many regions. We were honored to have FCC Commissioner Clyburn in our state multiple times to see firsthand the importance of broadband access to improving health outcomes throughout Mississippi.

More can and should be done. Legislation authored by Chairman Wicker would improve the validity and reliability of wireless coverage and expand broadband to rural areas and communities that are truly in need. S. 1621, the Rural Wireless Act, will help close the digital divide experienced by many, especially in rural and remote geographic areas, where disease burden is greatest.

We also support S. 1988, the Streamlining Permitting to Enable Efficient Deployment of Broadband Infrastructure Act of 2017 (SPEED Act). This bill will eliminate delays that often raise costs and slow the deployment of broadband to rural areas. It will also fast-track the deployment of next generation broadband that is critical to advancing innovative technologies in telemedicine.

The benefits of telehealth are not available to patients without access to high speed Internet across America. As technology and healthcare services expand to meet patients where they live, broadband coverage must improve to make this care accessible.

Thank you for taking the time to focus on how access to broadband in rural areas can help to close the digital divide, bring health care resources to remote communities and create a connectedness that transcends location. Without broadband, health care cannot operate outside of America's hospitals and clinics and cannot harness the power of technology to better treat our patients. Thank you for inviting me to testify today and for your time and attention to this very important matter.

Senator WICKER. Thank you, Mr. Adcock.

Mr. Armitage.

STATEMENT OF DAVID L. ARMITAGE, CEO/FOUNDER, CARTASITE

Mr. ARMITAGE. Good morning, Chairman Wicker, members of the Subcommittee. Thank you for inviting me in today. I am David Armitage, Chief Executive Officer of Cartasite. I founded the company in 2004 to bring real-time operational intelligence to the oil and gas industry.

During the fall of 2014, a response to precipitous declines in commodity prices, the oil and gas industry moved from "drill baby drill" to "tighten the belt; the ride is getting rough." The domestic oil and gas industry is resilient and resourceful. In the past 20 years, horizontal drilling and hydraulic fracturing technologies have opened up resources in the U.S. that have us on a path to energy self-sufficiency. That reality would have seemed like a fantasy two decades ago. The implications for the U.S. economy and geopolitics are profound. The U.S. is on track to exceed the country's all time high of 10 million barrels a day reached in November 1970.

Despite all of the success the industry has realized in reducing costs to find the next barrel of oil, we are still a relatively high-cost producer. The industrial Internet of Things is not hype or Silicon Valley's latest buzz word. IoT is helping to streamline business process, enhance safety, reduce environmental impact, and improve utilization of critical assets. Every aspect of energy production is being impacted by real-time remote monitoring, predictive analytics, cloud computing, smart sensors, advanced automation, and

remote monitoring systems are pushing connectivity into remote areas to the benefit of rural communities.

But there is no free lunch. The margin squeeze of the past 3 years has been painful. Tens of thousands of workers have lost their jobs. The budgets of rural communities have been slashed, and many firms have been forced into bankruptcy. We have seen an upstream oil and gas workforce decline by over 20 percent.

The industry's rapid response to lower commodity prices provides an interesting Petri dish to study the implications, both good and bad, of the industrial Internet of Things on our society. In the past 3 years, the number of barrels produced per worker has increased by over 27 percent. We can find no other examples in recent history where an industry of such scale has managed such a dramatic increase in worker productivity. There may be several factors contributing to this remarkable increase, but there can be no question that the industry's embrace of industrial Internet of Things has played a significant role.

Industrial IoT utilizes remote sensors to deliver data to cloud servers, where algorithms sift through the telemetry to identify actionable insights that streamline business process. The connectivity implicit in this architecture is bringing wireless high-speed networks to remote areas of our country where population densities would otherwise not provide sufficient economic incentive for cellular and broadband carriers.

At Cartasite, we utilize real-time vehicle monitoring technology to help oil field workers get home safely to their families every night. Large corporations like Anadarko Petroleum, Encana, and ConocoPhillips leverage this IoT data to optimize deployment of field workers, resulting in reductions in crashes, traffic, fuel consumption, and emissions. These industry fleets traverse some of the nation's most remote areas and provide us with interesting insights.

We see firsthand the negative impact on productivity and safety that comes from a lack of cellular coverage, off the highway and off the major road networks. These companies have worked closely with cellular carriers to enhance coverage, in some cases even funding the deployment of new cell towers. It's that critical to their business. While well site and pipeline monitoring technology has been available for over 30 years, penetration remains surprisingly low in some areas. The cost and complexity of legacy systems has placed the technology beyond the reach of many operators. This is changing quickly.

Smartphones have accelerated the commoditization of sensors, GPS processors, and cellular modems. The industrial IoT is riding this wave and bringing to market simple tags with exotic capabilities. At Cartasite, we have a system in our labs which is able to detect unintended methane leaks from remote well sites and report on these fugitive gas emissions over the cellular network. This data feeds into worldVIEW, a real-time geospatial dash board that companies can use to dispatch inspection and repair crews.

Methane is a significant greenhouse gas, some 80 times worse than CO_2 for our planet. The industry has worked closely with the EPA to reduce these unintended fugitive emissions, and our Project Canary is an outstanding example of the industrial IoT technology

which will help lessen the environmental impact of oil field operations.

The digital oil field is ushering in a new era of efficient, safer, and more cost-effective field operations. The industry is rapidly moving from management by schedule to management by exception, driven by the real-time insight garnered from these remote monitoring technologies. The oil and gas industry is embracing these technologies to ensure the safety of their workers, the security of critical assets, and the economic viability of the industry.

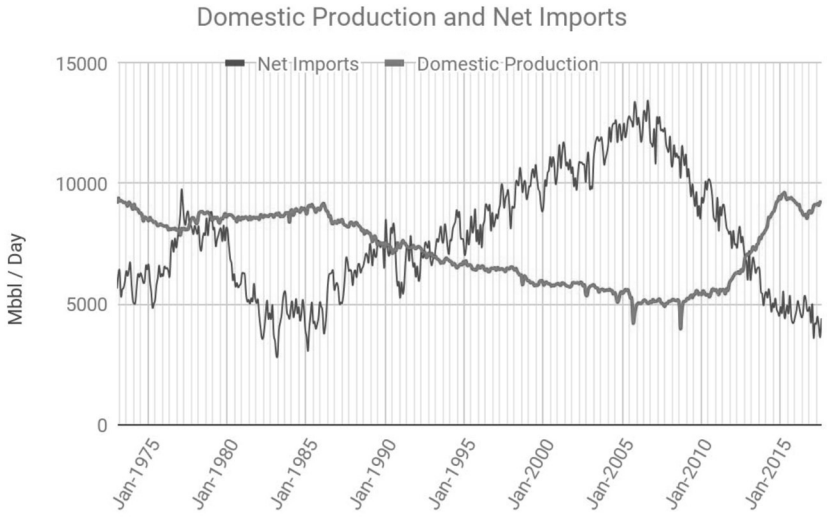
Thank you.

[The prepared statement of Mr. Armitage follows:]

PREPARED STATEMENT OF DAVID L. ARMITAGE, CEO/FOUNDER, CARTASITE

During the fall of 2014, in response to precipitous declines in commodity prices, the oil and gas industry moved from *drill baby drill* to *tighten the belts, the ride's gettin' rough.*

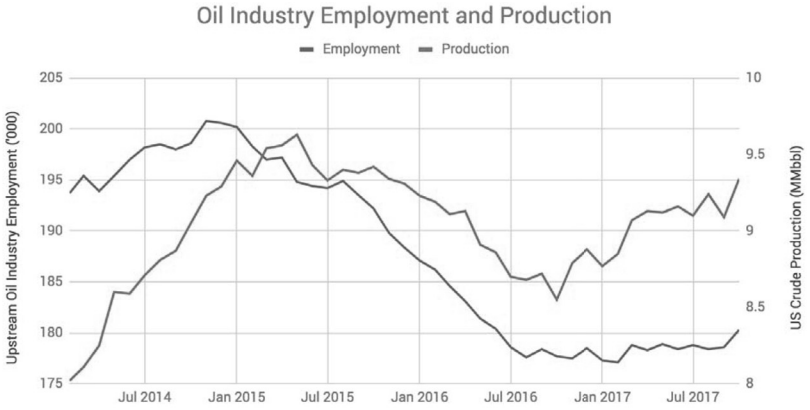
The domestic oil and gas industry is resilient and resourceful. In the past 20 years, horizontal drilling and hydraulic fracturing technologies opened up re-sources in the U.S. that have us on a path to energy self-sufficiency. The U.S. is on track to exceed the country's all time high of 10 MMbbl/day reached in November of 1970. That reality would have seemed like a fantasy two decades ago. The implications for the U.S. economy and geopolitics are profound.



Source: Energy Information Administration

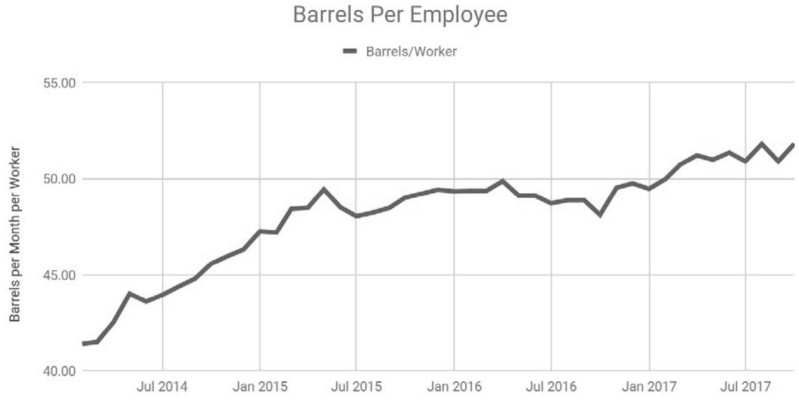
Despite all the success the industry has realized in reducing the costs to find the next barrel of oil, we are still a relatively high cost producer. The Industrial Internet of Things is not hype or Silicon Valley's latest buzzword. IoT is helping to streamline business process, enhance safety, reduce environmental impact, and improve utilization of critical assets. Every aspect of energy production is being impacted by realtime remote monitoring, predictive analytics, Cloud computing, smart sensors, and machine learning. Advanced automation and remote monitoring systems are pushing connectivity into remote areas, to the benefit of rural communities. But there is no free lunch.

The margin squeeze of the past three years has been painful. Tens of thou-sands of workers have lost their jobs, the budgets of rural communities have been slashed, and many firms have been forced into bankruptcy. We have seen the upstream oil and gas industry workforce decline over 20 percent.



Source: Energy Information Administration and Bureau of Labor Statistics

The industry's rapid response to lower commodity prices provides an interesting petri dish to study the implications, both good and bad, of the Internet of Things on our society. In the past three years the number of barrels produced per worker has increased by over 27 percent. We can find no other examples in recent history where an industry of such scale has managed such a dramatic increase in worker productivity. There may be several factors contributing to this remarkable increase, but there can be no question that the industry's embrace of Industrial IoT has played a significant role.



Source: Energy Information Administration and Bureau of Labor Statistics

Industrial IoT utilizes remote sensors to deliver data to the Cloud servers where algorithms sift through the telemetry to identify actionable insights that stream-line business response. The connectivity implicit in this architecture is bringing wireless, high speed networks to remote areas of our country where population densities would otherwise not provide sufficient economic incentive for cellular and broadband carriers. At Cartasite, we utilize realtime vehicle monitoring technology to help oil field workers get home safely to their families every night. Large corporations like Anadarko Petroleum, Encana, and ConocoPhillips leverage this IoT data to optimize deployment of field workers, resulting in reductions in crashes, traffic, fuel consumption, and emissions. These industry fleets traverse some of the Nation's most remote areas and provide us with some interesting insights. We see first hand the negative impact on productivity and safety that come from a lack of cellular coverage off of the highway and major road networks. These companies have worked

closely with the cellular carriers to enhance coverage, in some cases even funding the deployment of new cell towers.

Remote worker safety is a critical issue for many industries, including oil and gas, utilities, forestry, agriculture, and rail. The lack of cellular coverage has led industry to seek out alternative systems, including private radio networks and satellite beacons. As coverage is enhanced we can anticipate more effective integration with state and Federal emergency response infrastructure.

While wellsite and pipeline monitoring technology has been available for over thirty years, penetration remains surprisingly low in many areas. The cost and complexity of legacy systems has placed the technology beyond the reach of many operators. This is changing quickly. Smartphones have accelerated the commoditization of sensors, GPS processors, and cellular modems. Industrial IoT is riding this wave and bringing to market simple tags with exotic capabilities. At Cartasite, we have a system in our labs which is able to detect unintended methane leaks from remote wellsites and report on these 'fugitive' gas emissions over the cellular network. This data feeds into worldVIEW, a realtime geospatial dashboard that companies can use to dispatch inspection and repair crews. Methane is a significant greenhouse gas, some 80 times worse than CO_2 for our planet. The industry has worked closely with the EPA to reduce these unintended fugitive emissions and our Project Canary is an outstanding example of an Industrial IoT technology which will help lessen the environmental impact of oil field operations.

The Digital Oilfield is ushering a new era of highly efficient, safer, and more cost-effective field operations. The industry is rapidly moving from 'management by schedule' to 'management by exception' driven by the realtime insights garnered from remote monitoring technologies. The oil and gas industry is embracing these technologies to ensure the safety of their workers, the security of critical assets, and the economic viability of the industry.

Senator WICKER. Thank you, Mr. Armitage.

Mr. Hassinger, have I pronounced your name correctly?

Mr. HASSINGER. Yes, you have.

Senator WICKER. We're glad to have you with us.

Mr. HASSINGER. Thank you.

STATEMENT OF TIMOTHY HASSINGER, PRESIDENT AND CEO, LINDSAY CORPORATION

Mr. HASSINGER. Good morning, Senators. I'd like to thank Subcommittee Chairman Wicker, Ranking Member Schatz, Senator Deb Fischer, and all the members of the Subcommittee for this opportunity to testify in today's hearing.

My name is Tim Hassinger. I'm the President and Chief Executive Officer of Nebraska-based Lindsay Corporation, a leading manufacturer of center pivot and lateral move agricultural irrigation systems. For more than 50 years, Lindsay Corporation has been at the forefront of research and development of products and services designed to meet the world's rapidly growing agriculture and transportation needs. It's an honor and privilege to be here today representing my company and the agricultural industry. I'd like to thank Senator Fischer for inviting me to speak about the important role broadband access plays in the agricultural industry in operations of all sizes and in all regions of the country.

As you might know, it's estimated that by 2050, the global demand for food will be 60 percent higher than it is today. To meet this daunting challenge, it's imperative that we develop and deploy technologies that will help growers produce more with less while preserving water and other natural resources. Broadband access is the key to unlocking the power of these technologies, and, respectfully, Senators, I ask the question: Would you be able to do your job without access to the Internet? Probably not, and neither can farmers.

So like all business owners, farmers need to be online. The Internet fuels the innovative advanced technology that will help them meet the food, fuel, and fiber needs of the rapidly growing global population. With the touch of a button or swipe of a finger, farmers who have broadband access can receive commodity price information, monitor and respond to challenging weather conditions, get real-time data on soil moisture conditions, store and analyze data to increase sustainability and productivity.

They can also take advantage of the many new technologies now available from Lindsay Corporation and other American manufacturers. Among other things, these innovations enable remote data collection, transfer and analysis from connected devices like soil moisture sensors, weather stations, and cloud-based support tools. Farmers are using this information to streamline their operations and maximize efficiency and increase productivity.

We work with farmers every day, so we know the power that comes with the ability to leverage big data. We now offer technology that helps farmers decide precisely when, where, and how input to maximize yields while reducing overwatering, and then, ultimately, input costs and nutrient losses. In recently conducted field studies, our researchers found that remote telemetry streamlined growing operations in several key ways, including 3 percent increase in corn yield, a 17 percent reduction in water usage, $10 per acre reduction in energy costs, 75 percent reduction in time spent going back and forth in the fields.

This combination of yield enhancement and resource savings can increase American farmers' profits by an average of $40 per acre, profits that can be re-invested in their operation and in their local economy. For farmers across the country, these technologies are no longer luxuries. Rather, they're critical tools needed to increase the overall operational efficiency and productivity needed to compete in the global marketplace. However, farmers can only employ these connected tools if they have reliable, high-speed Internet access, and for an estimated 39 percent of the rural population, it's simply not available.

While cities and municipalities typically have access to several high-speed Internet service providers, that access often ends at the county line. Those living in rural communities depend on radio network, satellite, or cell service, all of which typically operate at lower speeds, limiting connectivity. It's a competitive world, and many people living in rural communities feel like they're being left behind, that they're not operating on a level playing field. In order for those communities and our country to thrive and compete in the global marketplace, we must bridge that digital divide.

With rural broadband access, business owners will have access to new markets and employees, healthcare workers will be able to access advanced equipment, students will be afforded new educational opportunities, and farmers will be able to take advantage of emerging technologies that will help them increase yields while conserving water and other natural resources.

Thank you.

[The prepared statement of Mr. Hassinger follows:]

PREPARED STATEMENT OF TIMOTHY HASSINGER, PRESIDENT AND CEO, LINDSAY CORPORATION

Good morning Senators. I would like to thank Subcommittee Chairman Wicker, Ranking Member Schatz, Senator Deb Fischer and all of the members of the subcommittee for this opportunity to testify at today's hearing.

My name is Tim Hassinger. I am the president and chief executive officer of Nebraska-based Lindsay Corporation—a leading manufacturer of center pivot and lateral move agricultural irrigation systems. For more than 50 years, Lindsay Corporation has been at the forefront of research and the development of products and services designed to meet the world's rapidly growing agriculture and transportation needs.

It's an honor and a privilege to be here today representing my company and the agriculture industry. I would like to thank Senator Fischer for inviting me to speak about the important role broadband access plays in the agriculture industry—on operations of all sizes in all regions of the country.

As you may know, it's estimated that by 2050, the global demand for food will be 60 percent higher than it is today. To meet this daunting challenge, it's imperative that we develop and deploy technologies that will help growers produce more with less, while preserving water and other natural resources.

Broadband access is the key to unlocking the power of those technologies. Respectfully, Senators—could you do your job without access to the Internet? Probably not—and neither can our Nation's farmers.

Like all business owners, farmers need to be online. The Internet fuels the innovative, advanced technology that will help them meet the food, fuel and fiber needs of the rapidly growing global population.

With the touch of a button or swipe of a finger, farmers who have broadband access can:

- Receive commodity price information
- Monitor and respond to changing weather conditions
- Use GPS for planting and irrigation management
- Get real time data on soil and moisture conditions
- Connect with other farmers and agriculture experts, and
- Store and analyze data to increase sustainability and productivity

They can also take advantage of a myriad of new technologies now available from Lindsay Corporation and other American manufacturers. Among other things, these innovations enable remote data collection, transfer and analysis from connected devices like soil moisture sensors, weather stations and cloud-based support tools. Farmers are using this information to streamline their operations, maximize efficiency and increase productivity.

We work with farmers every day, so we know the power that comes with the ability to leverage big data. We now offer technology that helps farmers decide precisely when, where and how much to irrigate—maximizing yields while reducing overwatering and related input costs and nutrient losses.

In recently conducted field studies, our researchers found that remote telemetry streamlined growing operations in several key ways, including:

- 3 percent increase in corn *yield* (driving profit of $25 per acre)
- 17 percent reduction in *water usage* (saving more than 9.25 million gallons on a 130 acre field)
- $10/acre reduction in *energy costs*
- 75 percent reduction in *time* spent going back and forth to the fields (another $5/acre saved)

This combination of yield enhancement and resource savings can increase American farmers' profits by an average of $40 per acre—profits that can be reinvested in their operation and in their local economy.

For farmers across the country, these technologies are no longer luxuries. Rather, they are critical tools needed to increase the overall operational efficiency and productivity needed to complete in the global marketplace.

However, farmers can only employ these connected tools if they have reliable, high-speed Internet access—and, for an estimated 39 percent of the rural population (23.4 million Americans), it's simply not available.

While cities and municipalities typically have access to several high-speed Internet service providers, that access often ends at the county line. Those living in rural

communities depend on radio networks, satellite or cell service—all of which typically operate at lower speeds, limiting connectivity.

It's a competitive world, and many people living in rural communities feel like they're being left behind—that they're not operating on a level playing field.

In order for those communities and our country to thrive and compete in the global marketplace, we must bridge that digital divide.

With rural broadband access, business owners will have access to new markets and employees; health care workers will be able access advanced equipment; students will be afforded new educational opportunities; and farmers will be able to take advantage of emerging technologies that will help them increase yields while conserving water and other natural resources.

Senator WICKER. Thank you very much.

Mr. Terzich.

STATEMENT OF MICHAEL TERZICH, CHIEF ADMINISTRATIVE OFFICER, ZEBRA TECHNOLOGIES

Mr. TERZICH. Thank you, Chairman Wicker, Ranking Member Schatz, and members of the Subcommittee, for the opportunity to testify before you today.

While many Americans may not recognize Zebra by name, they come into contact with our solutions every day. For example, the bar code labels that are prominently featured on airline bag tags, express delivery packages, and pharmaceutical prescription bottles are often generated by Zebra bar code label printers and tracked and managed by Zebra scanners and mobile computers.

We are also global leaders in bringing enterprise Internet of Things, solutions to business-to-business and business-to-government markets. With revenues of approximately $3.6 billion and 7,000 employees in more than 40 countries, Zebra is a trusted business partner with more than 95 percent of all Fortune 500 companies. We work with companies all across America, including many in rural communities.

Zebra leads the growing category known as Enterprise Asset Intelligence, EAI, which describes the ability of businesses to track critical assets within their operation and know exactly what they are, where they are, and their condition so they can make smarter, faster decisions that improve their bottom line. Zebra's customers recognize that people, asset, and devices—especially mobile devices—are becoming increasingly connected and that this trend is advancing at an exponential rate. A few key facts: By 2020, there will be 1.75 billion global mobile workers, accounting for 42 percent of the global workforce. By 2020, there will be 21 billion connected devices in a global IoT.

As a result, Zebra is working with companies across the U.S. to provide solutions that yield real-time visibility into their process, assets, people so that faster and more informed decisions can be made. Businesses, including those in rural America, are recognizing the transformational role of IoT solutions. These companies represent many sectors and deploy these solutions to address a variety of strategic and operational challenges.

The following are some industry sector examples being put to use in companies across rural America. In the manufacturing sector, companies are adopting IoT solutions in the smart factory which are providing actionable visibility to the entire operation as well as to vendors who can help manage the supply chain.

Whirlpool Corporation wanted to optimize mobile device management at its distribution centers. They needed a centralized management system to track device health, productivity, and ensure proper deployment. To solve these issues, Whirlpool began using Zebra mobile computers and vehicle mounted computers and Zebra's operational visibility service or OVS. OVS helps right-size equipment and understand site-by-site needs.

For the retail industry, when it comes to the Internet of Things, stores are paying attention. Recent research indicates 70 percent of retail decisionmakers are ready to make changes required to adopt IoT, and while 21 percent have implemented IoT, another 27 percent are planning to deploy within a year.

The Bon-Ton Stores are a prime example of how retailers are using Zebra's IoT solutions to improve the in-store customer experience. Today, associates in more than 180 Bon-Ton retail department stores use Zebra's RFID handheld readers on a daily basis to streamline the display compliance process. Store audits revealed that with a previously used manual system, up to 20 percent of merchandise in certain categories might be missing from the sales floor during a given week.

The RFID inventory system provides Bon-Ton with a deeper visibility into what merchandise is available at all times. It dramatically increases inventory management efficiencies by allowing store associates to scan and tag new merchandise as it first arrives in the store.

For companies in rural America to successfully utilize these B-to-B IoT solutions, there is one universal and vital resource. They must have unfettered access to high-quality, high-speed broadband, both wireless and wireline. Without investment in broadband infrastructure in rural communities, companies, healthcare providers, and consumers will be left behind. Spectrum is the lifeblood of IoT, and that is no different for business IoT solutions.

We applaud the work of this Subcommittee to examine the needs of companies in rural America, to ensure they reap the full benefits of IoT. We support infrastructure legislation that promotes the deployment of mobile broadband networks, as well as directs the NTIA and FCC to allocate more commercial licensed and unlicensed spectrum in a technology neutral way. Additionally, we urge Congress to advance policies that increase broadband investment and deployment in rural America.

Zebra also supports coordination among government agencies to discourage overlapping government regulation of the Internet of Things which could impede innovation. We congratulate the Committee for your work to pass the DIGIT Act to help ensure the industry can continue to roll out new technologies to improve the lives of American workers.

In conclusion, IoT presents a transformative opportunity for enterprise of all types and sizes all over the United States. The benefits of B-to-B IoT solutions are allowing companies to work smarter, enhance productivity, create jobs, and improve the overall economy. At Zebra, we are committed to bringing IoT solutions to companies to help them work better and smarter, giving them a performance edge.

Thank you for the opportunity to share our story.

[The prepared statement of Mr. Terzich follows:]

PREPARED STATEMENT OF MICHAEL TERZICH, CHIEF ADMINISTRATIVE OFFICER, ZEBRA TECHNOLOGIES

Thank you, Chairman Wicker, Ranking Member Schatz and members of the Subcommittee, for the opportunity to testify before you today. My name is Michael Terzich and I am the Chief Administrative Officer for Zebra Technologies. Zebra Technologies Corporation ("Zebra") is a global leader in bringing enterprise Internet of Things (IoT) solutions to Business-to-Business (B2B) and Business-to-Government (B2G) markets. With revenues of approximately $3.6 billion and 7,000 employees in more than 40 countries, Zebra is a trusted business partner with more than 95 percent of all Fortune 500 companies. We work with companies all across America, including in many rural communities.

While many Americans may not recognize Zebra by name, they come into contact with our solutions every day. For example, the barcode labels that are prominently featured on airline bag tags, express delivery packages, and pharmaceutical prescription bottles are often generated by a Zebra barcode label printer, and tracked and managed by Zebra scanners and mobile computers.

Zebra leads the growing category known as Enterprise Asset Intelligence (EAI) which describes the ability of businesses to track critical assets within their operations and know exactly what they are, where they are, and their condition so they can make smarter, faster decisions that improve their bottom line. EAI leverages and recognizes the fact that people, assets, and devices—especially mobile devices—are becoming increasingly connected and that this trend is advancing at an exponential rate. A few key facts help illustrate this point:

- By 2020, there will be 1.75 billion global mobile workers accounting for 42 percent of the global workforce.[1]
- By 2020, there will be 21 billion connected devices in a global Internet of Things.[2]
- By 2020, there will be 44 zettabytes of data with 10 percent of it coming from the Internet of Things.[3]

As a result, Zebra is working with companies all across the United States to provide solutions that yield real-time visibility into their processes, assets, and people so that faster—and more informed—decisions can be made. The key elements which enable this work include:[4]

- *Sense.* The employment of unrivaled expertise in sensor and device connectivity enables companies to inter-connect devices to software and to mobile workers so that decision makers and workers alike have substantially more real-time visibility into operations.
- *Analyze.* Equally important, the provision of easy access to an unprecedented amount of data that EAI enables allows companies to plan more effective short- and long-term strategies by delivering real-time insights into the critical data captured by the sensors in connected devices.
- *Act.* The explosive growth of mobile devices across the private, public, and non-profit sectors enables management and workers at all levels to act on these visibility-driven insights in real-time, anytime and everywhere.

Businesses, including those in rural America, are recognizing the transformational role of IoT solutions. These businesses represent many sectors, including retail, manufacturing, consumer products, transportation, healthcare, government, oil/gas, and hospitality. Companies deploy these IoT solutions to address a variety of strategic, operational, and business challenges.

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[1] Source: Strategy Analytics as cited in *Visibility That's Visionary,* Zebra Technologies Corporation (May 31, 2016, 11:15 AM), *https://www.zebra.com/content/dam/zebra_new_ia/en-us/campaigns/brand-campaign/zebra-visibility-vision-report-en-us.pdf.*

[2] Source: Gartner Group as cited in *Visibility That's Visionary,* Zebra Technologies Corporation (May 31, 2016, 11:15 AM), *https://www.zebra.com/content/dam/zebra_new_ia/en-us/campaigns/brand-campaign/zebra-visibility-vision-report-en-us.pdf.*

[3] Source: Digital Universe Study as cited in *Visibility That's Visionary,* Zebra Technologies Corporation (May 31, 2016, 11:15 AM), *https://www.zebra.com/content/dam/zebra_new_ia/en-us/campaigns/brand-campaign/zebra-visibility-vision-report-en-us.pdf.*

[4] Source: Zebra Technologies Corporation, *Visibility That's Visionary,* (May 31, 2016, 11:15 AM), *https://www.zebra.com/us/en/cpn/visibility.html.*

The following are some industry sector examples being put to use in companies across rural America:

Manufacturing

In the manufacturing sector, companies are adopting IoT solutions and the smart factory. Through the principles of Manufacturing 4.0, the smart factory calls for providing actionable visibility to the entire operation as well as to those vendors who can help manage the supply chain. Workers use a combination of RFID, wearables, automated systems and other emerging technologies to monitor the physical processes of the plant and enable companies to make decentralized decisions. In the factory and across the supply chain, firms are also capitalizing on the Industrial Internet of Things (IIoT) to achieve real-time visibility into their goods, assets, processes and places.

Like other companies, Whirlpool Corporation wanted to optimize mobile device management at its distribution centers. Whirlpool was having problems with misplaced devices, battery life, the inability to update devices in a systematic way, and a lack of data metrics around device performance. They needed a centralized management system to track device health, productivity, location, and ensure proper deployment.

To solve their problem, Whirlpool began using Zebra XT15 mobile computers, VH10 vehicle-mounted computers, and Zebra's Operational Visibility Service (OVS). The VH10 and XT15 are extremely rugged, reliable devices that suit the distribution center well. OVS helps Whirlpool and long-time Zebra partner, Industrial Service Technology (IST) right-size equipment and understand the needs of the pool as well as site-by-site needs. This combination allows Whirlpool and IST to sense when there could be a problem, analyze what it is, and act on a solution in real-time.

As we see with the Whirlpool example, automation provides instant access to data which is essential to ensuring that the production process operates smoothly. Manufacturers are realizing the very real benefits of data connectivity: increased visibility into the entire manufacturing process; an accelerated pace in shipping and receiving; faster identification of points-of-failure; and deeper insights into the inner workings of their operations.

Transportation & Logistics

Companies within the Transportation & Logistics (T&L) sector literally deliver the U.S. economy. The movement of goods and people across America and the globe represents the backbone of the overall supply chain. In T&L, the challenge continues to be how to optimize delivery as the average floor-loaded trailer could carry 30 percent more cargo. With tablet-based, trailer load analytics software, warehouses and fleet managers are given a clear image and the load statistics of each trailer, allowing them to easily track fulfillment and ensure cargo loads reach their full potential.

For the movement of goods, companies must leverage IoT solutions to maintain visibility that is critical to customer service as well as quality assurance and traceability. Adherence to regulatory compliance requires visibility often across a complex chain of custody, and that visibility is gained by transforming the reality of storage, transport, and delivery into systems of record. For the movement of people, their baggage, and cargo, IoT solutions offer real-time visibility across a complex chain of airports, planes, carts, and baggage claim centers. In each of these scenarios, workers use locationing solutions with a wide array of purpose-built mobile computing, conditioned labels, RFID, and other emerging technologies to maintain real-time operational visibility.

For example, ArcBest Corporation, based in Fort Smith, Arkansas, ships high-value, time-critical freight anywhere in the world with the highest level of service in the industry. To fulfill its commitment to supply chain optimization and premium logistics, ArcBest uses robust analytics data and advanced technology to develop a supply chain strategy for its customers to minimize cost and improve the shipping and logistics process. Ultimately, the power of analytics gives ArcBest and its customers a competitive advantage.

Retail

The shift to IoT technologies is an industry imperative to keep step with the shopping habits and expectations of consumers reshaped by the tech revolution that's still unfurling. Digital disruption—most profoundly, online shopping and smartphones—has birthed ever connected, savvy shoppers who have the globe's grandest mall at their fingertips. And retailers, whether they realize it or not yet, are now largely catering to Millennials—who have eclipsed Baby Boomers as the world's largest shopping group and will comprise 75 percent of the global workforce by 2025.

The key takeaway here: this group born between 1980 and 1995 marks the first generation of digital natives, for whom technology is second nature.

When it comes to the Internet of Things, stores are paying attention: nearly 70 percent of retail decision makers are ready to make changes required to adopt IoT. Already, 21 percent have implemented IoT and another 27 percent are planning to deploy within a year.[5]

The Bon-Ton Stores, which operates Bon-Ton, Bergner's, Boston Store, Carson's, Elder-Beerman, Herberger's and Younkers stores, is a prime example of how retailers are using Zebra's IoT solutions to improve the in-store customer experience. Today, associates in more than 180 Bon-Ton retail department stores use Zebra's MC3190–Z RFID handheld readers on a daily basis to streamline the display compliance process and know with certainty that all available merchandise is on display.

As soon as associates arrive in the morning, they scan the selling floor using the MC3190–Z readers to compare items on display against on-hand inventories, helping them identify missing items that should be on the sales floor. Store audits revealed that with the previously used manual system, up to 20 percent of merchandise in certain categories might be missing from the sales floor during a given week, resulting in missed sales opportunities.

The RFID inventory system provides Bon-Ton with deeper visibility into what merchandise is available at all times. It dramatically increases inventory management efficiencies by allowing store associates to scan and tag new merchandise as it first arrives in-store so it can be immediately placed on display, leading to quicker item availability for shoppers and increased sales.

In rural America, retailers are seeking better ways to bridge their online presence with traditional brick-and-mortar stores through cross-channel selling. Having the ability to collect information, at every point whenever data changes status—from the manufacturer, through the distributor, to the sales floor—is significant. Coupling this data with sales and marketing metrics collected from fixed point-of-sale (POS) devices and smartphones can pay big dividends in driving customer loyalty programs. When properly implemented, retailers can link their smart devices together with their data center and capitalize on each facet of Big Data.

Healthcare

Heavily regulated and moving to further digitization, the healthcare industry faces major hurdles in the drive to improve patient safety, enhance worker efficiency, and control costs. Electronic health records (EHRs) adoption paves the way for maintaining detailed, accurate, and life-long individual patient records. In addition, medical facilities leverage RFID tags to achieve 100 percent asset visibility, which helps reduce theft, optimize response times and improve asset utilization by medical staff.

With the right IoT solution, healthcare professionals can integrate with EHR systems, minimizing medication and laboratory errors, while maximizing patient safety and improving the quality of care. One example is our work with Avera Health, an integrated health system based in Sioux Falls, serving South Dakota and surrounding areas of Minnesota, Iowa, Nebraska and North Dakota. Avera Health serves a population of nearly one million people through 33 hospitals, 208 primary and specialty care clinics, and 40 senior living facilities. Based on our partnership with Voalte, Zebra's technology is being used by Avera Health to improve patient outcomes by integrating voice calls, text messaging, and alarm and alert notifications on one enterprise smartphone platform. These technologies also work to improve the discharge process to speed patient throughput, streamline the medication order process and optimize alarm management to ensure patient safety.

B2B IoT Solutions Depend on Access to High-Speed Broadband

For companies in rural America to successfully utilize B2B IoT solutions, they must have unfettered access to quality high-speed broadband, both wireline and wireless. Without investment in broadband infrastructure in rural communities, companies, healthcare providers, and consumers will be left behind. Spectrum is the lifeblood of IoT, and that is no different for business IoT solutions.

We urge this subcommittee and the full Committee to support infrastructure legislation that promotes the deployment of mobile broadband networks, as well as directs the NTIA and FCC to allocate more commercial licensed and unlicensed spectrum in a technology neutral way. Additionally, we urge Congress to advance policies that increase broadband investment and deployment in rural America.

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[5] Source: *Zebra's 2017 Retail Vision Study*

Zebra also supports coordination among government agencies to discourage overlapping government regulation of the Internet of Things which could impede innovation. We congratulate the Committee for your work to pass the DIGIT Act, and thank you for your efforts to ensure that industry has the ability to continue to roll out new technologies to improve the lives of American workers.

In Conclusion

IoT presents a transformative opportunity for enterprises of all types and sizes all over the Unites States. The benefits of B2B IoT solutions are allowing companies to work smarter, enhance productivity, create jobs and improve the overall economy. At Zebra, we are committed to bringing IoT solutions to companies to help them work better and smarter, giving them a performance edge. Thank you for the opportunity to share our story.

Senator WICKER. Thank you very much.

Our next witness is Angela Siefer. Is that correct—Siefer?

Ms. SIEFER. Yes, sir.

Senator WICKER. Ms. Siefer, tell us about your organization and digital inclusion.

STATEMENT OF ANGELA SIEFER, EXECUTIVE DIRECTOR, NATIONAL DIGITAL INCLUSION ALLIANCE

Ms. SIEFER. Thank you. My name is Angela Siefer. I appreciate Chairman Wicker and Ranking Member Schatz and all of you for having me here today.

I am the Executive Director of the National Digital Inclusion Alliance. We are a unified voice for digital inclusion programs and policies. By digital inclusion, we are referring to public access, home access, digital literacy skills, appropriate devices, and tech support. It's incredible that you all are wrapping in the broadband issue with IoT today. I think that's fabulous.

I grew up outside of Lima, Ohio, which is about an hour from Dayton. My father passed away about 5 years ago, and he had this device from the VA. It was a precursor to an IoT, and what it did was take his vitals. He had COPD, which means that he couldn't breathe. So when they would take his vitals, multiple times, a nurse—whoever knows where that nurse was, right—would see that he was in distress and call the squad.

So that device, that precursor to an IoT, saved his life multiple times, and what that gained for us was time with my dad, and it allowed him to live at home instead of someplace else. But none of that would have been possible without broadband. He had broadband connection in his home. The device was connected to the broadband.

So as you all are figuring this out—as we as a country are figuring out IOT, we have to look at the broadband and not just the infrastructure but the adoption, and it's fabulous that that was brought up multiple times today, because we have to have both in order to get anywhere.

The biggest issue that we have right now is that we don't have a unified strategy. So there are a handful of programs for infrastructure, Federal programs. I can tell you there are no functioning broadband adoption Federal programs right now. I would like to tell you otherwise, but that's not true. We need both. We need a Federal strategy that addresses infrastructure and addresses adoption, and we need to do it together. We can't just say one and then the other. So we have to address them both.

The very first thing we can do—because that's a really big ask. I understand that. The first thing we can do is figure out the data. Right now, the data that we have is—mostly, what we use is from the FCC. It's functional. It tells us who has what data. But if you ask anyone in the field if it's accurate, no, it's not accurate. That's a huge problem.

So the FCC has recently asked for comments on their Form 477 data. That's great. That needs to seriously change, how they bring in that data, because that's the first step, because having the data is what gets us to the maps, and that's both important nationally and locally. So I ask you to consider that we all could work together to figure out a strategy for getting to the IoT, in order to get to the strategy for IoT, that we get to a broadband strategy.

Thank you, sir.

[The prepared statement of Ms. Siefer follows:]

PREPARED STATEMENT OF ANGELA SIEFER, EXECUTIVE DIRECTOR, NATIONAL DIGITAL INCLUSION ALLIANCE

Chairman Wicker, Ranking Member Schatz, and Members of the Subcommittee, thank you for the opportunity to be here today on behalf of the National Digital Inclusion Alliance (NDIA) and our 285 affiliated organizations.

NDIA represents leaders of local community organizations, public libraries, municipalities and other institutions working hard to reduce digital disparities among neighbors. To improve the daily lives of all community members, NDIA calls for digital inclusion public policies that reflect our affiliates' expertise and diverse experiences.

NDIA's approach is based in the knowledge that broadband adoption is most effectively promoted by community-driven efforts combining:

- Affordable home broadband service.
- Public broadband access.
- Appropriate affordable devices.
- Locally trusted technology training and support.

NDIA represents organizations with a wide range of experience reducing the digital divide in the United States. The experiences of our affiliates include providing guidance to low-income parents connecting to their children's teachers, teaching seniors how to use their electronic health records, helping veterans learn digital skills in order to acquire a job, and enabling disabled adults to participate more fully in their communities. The services of our affiliates include digital literacy training, public Internet access, home broadband programs and digital inclusion advocacy.

NDIA currently counts 285 affiliated organizations, including 39 national nonprofits and 210 local public and nonprofit organizations in 37 states, the District of Columbia and the U.S. Virgin Islands. Our local affiliates include 23 municipal government bodies, 39 local public libraries and regional library councils, 14 college/university programs, 10 state government agencies, 3 local school districts, 7 housing authorities and 114 local nonprofit organizations. The full list of NDIA affiliates with links to their websites can be found at https://digitalinclusion.org/members.

The members of this subcommittee clearly recognize the incredible impact IoT can and will have on the U.S. economy and our residents.

My father passed away five years ago. He had chronic obstructive pulmonary disease. I grew up outside of Lima, Ohio. The closest VA clinic to my parents was in Dayton, Ohio, about an hour away. The VA provided my dad with a device that measured his vitals, including his oxygen levels. The device used my parents' Internet connection. I have no idea where the nurse was but somewhere, a nurse reviewed the data from the device. When necessary, the nurse called the squad for my dad. That device, a precursor of the IoT, saved my dad's life multiple times. It bought my family time with him. And it allowed him to live at home. That would not have been possible without an Internet connection.

But in order for the U.S. to have an IoT strategy that benefits all Americans, we must understand the barriers to broadband adoption.

The FCC's "2016 Broadband Progress Report" found that 10 percent of all Americans (34 million people) lack access to 25 Mbps/3 Mbps service. 39 percent of rural

Americans (23 million people) lack access to broadband service as the FCC defines it—25 Mbps/3 Mbps.[1]

These numbers tell us how many Americans lack access to broadband service. But just because service is available to the home does not ensure the resident has subscribed to it, or can subscribe. We know the greatest barriers to home broadband adoption beyond the infrastructure itself are cost of the service and digital skills.

Pew Research Center tells us that in 2016, 73 percent of urban U.S. adults used broadband at home. This drops to 63 percent for rural U.S. adults.[2] Neither is acceptable. We are beyond discussing whether or not home broadband is essential today. Now we must discuss how we ensure all Americans have affordable home broadband and digital skills in order to not only make the most of the Internet on a computing device but to also make the most of IoT. The more of us purchasing and using IoT, the more valuable those IoT are.

Right now, efforts to address lack of infrastructure and cost of broadband service and digital skills trainings are local. The Federal government has a handful of programs addressing infrastructure, but those efforts are operating without a cohesive Federal strategy.

I can say without a doubt, we have *no* substantial Federal programs addressing either the cost of broadband or digital skills. The United States needs an organized Federal strategy to increase broadband access and adoption.

There has been a consistent 10–15 percent gap in adoption rates between rural and urban areas going back to the early 2000s. Research shows rural broadband *adoption* (not just access) is crucial for improved economic outcomes.[3]

The first step toward such a strategy is to improve access and adoption data. Let's start with the FCC's basic data source—Form 477.

NDIA recently took the opportunity to submit comments in response to the FCC's Further Notice of Proposed Rulemaking "In the Matter of Modernizing the FCC Form 477 Data Program". A copy of those comments is submitted with these remarks. To summarize them very briefly:

(1) The FCC's Form 477 process has a significant problem with the way it collects fixed broadband deployment information. Providers are required to report, for each technology used in each Census block, only the Maximum Advertised Download Speed and Maximum Advertised Upload Speed available to any residential customer in the block. Of course, that lucky maximum-speed customer isn't necessarily typical of the neighbors. This method has the effect of exaggerating the speeds available to most households in both urban and rural communities. It's a serious impediment to our realistic understanding of the state of broadband access throughout the U.S. NDIA suggests a simple fix: Form 477 should require each provider to list, for each home broadband technology deployed, the speed tiers provided via that technology to households in each block, and the number of households in the block for which each tier is the maximum available.

(2) Form 477 also provides the only localized information we have on actual household broadband adoption, in the form of Census tract-level fixed broadband subscription counts used to create the FCC's Internet Access Services mapping data. NDIA suggested two modest changes in the FCC's collection and reporting of the provider subscription data incorporated in the Internet Access Services reports: Collect household totals for each tract at three or four meaningful speed benchmarks, not just the current 200 kbps and 10 mbps thresholds; and publish those totals as actual percentages of total households, rather than the unnecessarily broad ranges now in use.

The point of these recommendations is the need to improve the accuracy and usefulness of the broadband deployment and adoption data that the FCC collects, maps, and reports to us all—the data that informs public discussion of the Nation's progress in making both the Internet of Things and the Internet of People available to us all.

With better public data on both topics—and a clear understanding that the Internet of Things isn't likely to make its way into homes that either can't access or can't

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[1] Federal Communications Commission. "2016 Broadband Progress Report". January 29, 2016. *https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2016-broadband-progress-report*

[2] Pew Research Center. "Internet/Broadband Fact Sheet". January 12, 2017. *http://www.pewinternet.org/fact-sheet/internet-broadband/*

[3] Brian Whitacre, Roberto Gallardo, and Sharon Strover. 2014a. "Broadband's Contribution to Economic Growth in Rural Areas: Moving towards a Causal Relationship." *Telecommunications Policy* 38(11): 1011–1023. *http://www.sciencedirect.com/science/article/pii/S0308596114000949*

afford conventional broadband connections—NDIA is certain we have a much better chance of making the benefits of IoT available to all Americans, rural and urban alike.

I must stress, again, the need for the U.S. to have a cohesive and funded broadband access *and* adoption strategy.

Thank you.

ATTACHMENT

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Modernizing the FCC Form 477 Data Program	)	WC Docket No. 11-10

COMMENTS OF THE NATIONAL DIGITAL INCLUSION ALLIANCE

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September 25, 2017

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Introduction

The National Digital Inclusion Alliance (NDIA) respectfully submits these comments in response to the FCC's Further Notice of Proposed Rulemaking "In the Matter of Modernizing the FCC Form 477 Data Program" (WC Docket No. 11-10).

We are leaders of local community organizations, public libraries, municipalities and other institutions working hard to reduce digital disparities among our neighbors. To improve the daily lives of all community members, we call for digital inclusion public policies that reflect our expertise and diverse experiences.

Our approach is based in the knowledge that broadband adoption is most effectively promoted by community-driven efforts combining:

- Affordable home broadband service.
- Public broadband access.
- Appropriate affordable devices.
- Locally trusted technology training and support.

The National Digital Inclusion Alliance represents organizations with a wide range of experience reducing the digital divide in the United States. The experiences of our 250+ affiliates include providing guidance to low-income parents connecting to their children's teachers, teaching seniors how to use their electronic health records, helping veterans learn digital skills in order to acquire a job, and enabling disabled adults to participate more fully in their communities. The services of our affiliates include digital literacy training, public Internet access, home broadband programs and digital inclusion advocacy.

NDIA currently counts 275 affiliated organizations, including 38 national nonprofits and 201 local public and nonprofit organizations in 35 states, the District of Columbia and the US Virgin Islands. Our local affiliates include 22 municipal government bodies, 37 local public libraries and regional library councils, 14 college/university programs, 9 state government agencies, 3 local school districts, 4 housing authorities and 113 local nonprofit organizations. The full list of NDIA affiliates with links to their websites can be found at https://digitalinclusion.org/members.

General perspectives

Paragraph 6 of the FNPRM refers to the Commission's interest in supporting the efforts of "*Others, including Congressional and state and Tribal policymakers, researchers, and consumers, [who] also rely on the data we collect for a variety of purposes.*"

NDIA commends the Commission and staff for recognizing this important function of Form 477 data, and for their interest in enhancing its usefulness to "policymakers, researchers and consumers". NDIA and many of our affiliated organizations fall into these categories, having found Form 477 Census tract and block data to be unique resources for local community analysis, policy development, strategic planning and programming to increase high-speed Internet access and adoption.

Appendix 1 shows examples of local and regional research and analysis efforts which have relied upon Form 477 data.

Our specific comments on the FNPRM reflect NDIA's local-user perspective, and are focused on a few topic areas in which our experience suggests that modest changes in the content or format of Form 477 Census tract and block data, as released to the public, would make it more accessible and useful to local "policymakers, researchers and consumers".

As background to those specific suggestions, however, we want to speak briefly to two broader points.

1. Form 477 Census subscription tract and Census block deployment data are uniquely valuable for community research and analysis aimed at digital inclusion.

At this time, and until Fall 2018 at the earliest, the only public data on broadband adoption and access for any U.S. geography smaller than a Census "place" of 20,000 is Form 477 Census tract subscription data and Census block deployment data. The Census' American Community Survey 1-Year Estimates offer computer ownership and Internet subscription data, but only for Census places above 20,000 -- with demographic detail only for places above 65,000. None of this data will be available at the tract level until computer/Internet data series are incorporated into the ACS 5-Year Estimates for 2017, due for release in Fall 2018. And while the ACS will provide a lot of useful granular detail at that point, including residential connection demographics and technology shares for tracts and possibly for block groups, it doesn't, and won't, include any information about local download or upload speeds.

So for local analysts and leaders trying to assess the opportunities for high-speed broadband access and the gaps in actual household connectedness in our communities, Form 477 data is now, and will continue to be, uniquely valuable.

This is an important framework for the Commission's deliberations on adding detail, granularity, and ease of access to the publicly available tract and block data. At the same time, it's a reason to take care that Form 477 data continues to be released in formats that can easily be aligned with more traditional community planning data such as income, ethnicity, age, education, housing ownership, etc.

2. *Our comments do not address the many questions in the FNPRM addressed to the treatment of mobile wireless services.* NDIA and our local affiliates have had no opportunity to use wireless mobile services data for the purpose of local planning and analysis, and thus have no basis for offering concrete recommendations in our comments. For this reason our specific comments here are addressed only to Form 477 fixed broadband deployment and subscription data.

But we do wish to reiterate the general concern we expressed in our recent comments filed in response to the Commission's Thirteenth Section 706 Report Notice of Inquiry [1]:

> *In judging and reporting whether advanced telecommunications capability has been deployed in local areas, the Commission should not conflate mobile wireless Internet access with fixed broadband services…*
>
> *NDIA and our affiliates generally support the collection and public release of any information which can improve our understanding of broadband access and costs, as factors which significantly affect digital inclusion in our communities. So we would welcome the addition of more detailed information regarding local mobile wireless broadband services to the Commission's public-record data.*
>
> *But in judging and reporting whether advanced telecommunications capability has been deployed in local areas, the Commission should not conflate mobile wireless Internet access with fixed broadband services…*
>
> *The availability of 4G mobile data service for individual devices... is a poor substitute for access to the power and flexibility of well-deployed fiber, cable or advanced DSL services.*
>
> *NDIA's affiliated digital inclusion practitioners see computers and mobile devices as separate elements of an "access ecology" that our low-income clients find themselves navigating. Both American Community Survey and Pew Research data confirm that most U.S. users of smartphones also own laptop computers. Those who don't own both tend to be poor, i.e. to be choosing mobile as their best use of scarce resources. In general it's cheaper to combine your personal phone and a limited amount of Internet access into one device. When that device is called upon to meet a child's homework needs, prepare resumes for*

[1] [FCC url for out Comments]

employers, manage spreadsheets or support participation in a college course, its limitations quickly become apparent.

Form 477 fixed deployment data issues

Section III- B-1-b. Fixed Deployment Data Reporting Generally

Paragraphs 33, 34 and 35 address a significant problem with the current system of reporting fixed deployment information -- a system in which providers report, for each technology used in each Census block, only the Maximum Advertised Download Speed and Maximum Advertised Upload Speed available to a single residential customer in the block.

This method has the effect of exaggerating the speeds available to households in both urban and rural blocks where deployment of leading technologies is uneven, e.g. where a technology's reported MADS and MAUS is be available to some addresses within a block but not others. Also, as the FNPRM says: "...it is impossible to tell whether residents of that block seeking service could turn to that provider for service or whether the provider would be unable or unwilling to take on additional subscribers. This may limit the value of these data to inform our policymaking and as a tool for consumers and businesses to determine the universe of potential Internet service providers at their location."

As a remedy, the Commission seeks *"comment on whether to require fixed broadband providers to indicate whether total customers served on a particular technology could be increased in each census block listed when they report deployment data. We specifically seek comment on whether all fixed broadband providers should be required to identify on Form 477 three categories of service areas for each technology code: (1) areas where there are both existing customers served by a particular last-mile technology, and total number of customers using that technology can, and would, be readily increased within a standard interval upon request; (2) areas where existing customers are served but no net-additional customers using that technology will be accommodated; and (3) areas where there are no existing customers for a particular technology but new customers will be added within a standard interval upon request."*

NDIA does not oppose this approach but respectfully submits that it is an unduly complicated approach to a simple problem. As an alternative, we suggest that *each provider be required to list, for each home broadband technology deployed, the speed tiers provided via that technology to households in each block, and the number of households in the block for which each tier is the maximum available.* [2]

[2] For example: AT&T would be required to report on the availability of VDSL, ADSL2 and Fiber To The Premises services (Tech Codes 11, 12 and 50) for a given block, the speed tiers offered for each, and the number of residential addresses in the block considered eligible for each technology/speed combination.

We can infer that speed-per-household information is readily available, at least to large wireline providers, because it is routinely provided to potential customers as an online screening mechanism (i.e. enter your address to see what packages are available there). And we know that providers must currently align that address-speed information with Census blocks; how else could they determine the address(es) in each block with the Maximum Advertised Download and Upload Speeds, and thus identify those speeds?

So with respect to the Commission's concerns in Paragraph 35, we suggest that NDIA's alternative is simply a more detailed reporting system for data the providers are already required to assemble to meet their Form 477 obligations, and therefore could be implemented with minimal added burden or cost.

From a community analysis and planning standpoint, NDIA's alternative is preferable because it would provide more complete, meaningful quantitative data regarding the actual broadband services available to residents at a small-neighborhood level, but without violating personal confidentiality or revealing closely held business information.

Section III-B-1-c. Granularity

Paragraphs 36 through 45 of the FNRPM explore and seek comment on several alternative methods for collecting Form 477 deployment data with greater granularity, ranging from allowing providers to submit detailed coverage maps rather than Census block data, to requiring submission of data for sub-block geographies like street segments or even geocoded households.

NDIA recognizes that the Commission's interest in this area relates mainly to its own use of 477 deployment data in its own proceedings, not to "other users" like community analysts and researchers. We also recognize that most "*policymakers, researchers, and consumers",* including those associated with our affiliates, would be inclined to support the most granular collection approach *which preserves or increases the public transparency of the data*.

NDIA does not have a clear preference for any of the alternative methods described in Paragraphs 36-44, or for the current system as opposed to any or all of them. However, we do have some cautions we ask the Commission to consider:

1) The technical risks and limitations of a system built on geocoding individual parcels, rather than on entering data by street address into geoidentified map segments such as Census blocks and tracts, are mentioned in the FNRPM. Please note that a "small" national 1% failure and/or error rate in geocoding Form 477 parcel or address data could easily involve much larger failure and/or error rates for many local communities, even rendering the data useless for their local purposes.

2) The smallest geography for which annual Census data is published on income, poverty, housing, household numbers and types, education, race, ethnicity, age, occupation, and other demographics is the Census block group. It's reasonably simple to align current Form 477 data, collected and published for Census blocks, with this demographic data for purposes of local community research and strategic analysis. When the Census begins publishing tract and block group-level ACS data on household computer ownership and Internet access in Fall 2018, this will become an even more important area for communities to explore.

   Would data collected and reported by street segments or geolocated parcels be useable by communities in the same Census-friendly way? If not, the Commission should proceed with any changes in ways that ensure the continued availability and enhancement of Form 477 deployment data in Census block form.

Form 477 fixed subscription data issues

Section III-C-1-b. Other data

In Paragraph 55, the Commission seeks *"comment on whether there are other Form 477 data that the Commission should consider making public. While we understand confidentiality concerns associated with making aspects of these data public, there are also significant potential benefits to consumers and public policy. We invite comment on what data should be made publicly available, and how to mitigate competitive and other concerns."*

The Form 477 data release which is most used by NDIA's affiliates for purposes of community analysis and strategic planning to reduce disparities in broadband adoption is the Census Tract Data on Internet Access Services, i.e. broadband subscription data.

NDIA asks the Commission to consider two simple but significant enhancements to the data included in this release. Neither change would raise a new issue of provider confidentiality. The first might require providers to file a very modest level of additional information, at a negligible cost.

1) Include data on fixed broadband connections at downstream speeds of 200 kbps, 3 mbps, 10 mbps and 25 mbps, with appropriate upstream benchmarks. Local researchers and planners (as well as the FCC, we'd think) would greatly benefit from the ability to make apples-to-apples comparisons going back several years, while the highest benchmark should (and we expect soon will) match the Commission's fixed deployment speed benchmark.

2) Convert the subscription-count data for each tract and speed benchmark to a simple percentage of Census households in the tract. The current map codes

representing 20-percentage-point cohorts (e.g. “between 200 and 399 subscriptions per 1,000 households”) obscure more useful information than they reveal. There is no good reason to keep them.

Form 477 data availability

Section III-C-3. Availability of Form 477 Data

In response to Paragraph 58, NDIA agrees that a more accessible and comprehensive map-based resource for making localized Form 477 data available to the public, similar to the former National Broadband Map, could improve the data’s usefulness to our affiliates.

To suggest a modest step in this direction: The map “Residential Fixed Internet Access Service Connections per 1000 Households by Census Tract” [3] on the FCC website could be a very valuable introduction to local Form 477 data for our local leaders, nonprofits and the general public if it offered more detail at closer magnification.

Conclusion

NDIA appreciates the opportunity to share our perspectives on these issues. We hope our comments are helpful in the Commission’s deliberation.

[3] https://www.fcc.gov/maps/residential-fixed-internet-access-service-connections-per-1000-households-by-census-tract/

Appendix 1. Examples of local and regional analyses, studies and tools that have used Form 477 Census tract subscription data and/or Census block deployment data

National Digital Inclusion Alliance (for the Cleveland Foundation), ***Informing Strategic Investment in Digital Equity: Cleveland/Cuyahoga County***, September 2017 [4]

Haas Institute, University of California at Berkeley, ***AT&T's Digital Divide in California***, April 2017 [5]

National Digital Inclusion Alliance and Connect Your Community, ***AT&T's Digital Redlining Of Cleveland***, March 2017 [6]

Dr. Roberto Gallardo, Center for Regional Development, Purdue University, ***The Digital Divide Index*** [7]

City of Kansas City, MO and Xact, ***KC Digital Inclusion map***, May 2017 [8]

Shruthi Arvind and Kyle Fee, Federal Reserve Bank of Cleveland, ***Broadband and High-speed Internet Access in the Fourth District***, December 2016 [9]

[4] https://digitalinclusion.org/cuyahoga-2017/
[5] http://haasinstitute.berkeley.edu/digitaldividecalifornia
[6] https://digitalinclusion.org/blog/2017/03/10/atts-digital-redlining-of-cleveland/
[7] https://www.pcrd.purdue.edu/signature-programs/digital-divide-index.php
[8] http://www.govtech.com/civic/Kansas-City-Mo-Maps-Data-Related-to-Digital-Inclusion.html
[9] https://www.clevelandfed.org/newsroom-and-events/publications/a-look-behind-the-numbers/albtn-20161208-broadband-and-high-speed-internet-access.aspx

Senator WICKER. Thank you very, very much.

I will now recognize members for questions, using the five-minute rule, and I will defer to later and recognize Senator Fischer.

STATEMENT OF HON. DEB FISCHER,
U.S. SENATOR FROM NEBRASKA

Senator FISCHER. Thank you, Mr. Chairman. Thank you for convening today's hearing to discuss the importance of technology and innovation that's driving the development of the Internet of Things across all sectors of our economy.

Chief among the industries supplying IoT innovations is production agriculture. Farmers and ranchers face high levels of risk that range from extreme weather conditions to fluctuating commodity markets. To counteract these challenges and remain competitive, ag producers rely on technological advancements to continue to provide for their families and also to feed a hungry world.

Today, I want to welcome Tim Hassinger, CEO and President of Lindsay Corporation, which is located in Omaha, Nebraska. While Mr. Hassinger is not new to production agriculture, he is new to Lindsay. He has been CEO a little less than a month. Prior to joining Lindsay, he was President and CEO of Dow AgroSciences. I want to thank him for testifying today about the technological needs of our nation's farmers.

Lindsay Irrigation System manufactures Zimmatic center pivots, which dot our Nation's countryside and provide essential natural resource enhancement capabilities. Nebraska is rich in groundwater, thanks to the Ogallala Aquifer. Innovators like Lindsay provide our ag producers with the resources and tools necessary so that they can maximize yields, safeguard the soil, and better manage our pressure water resources. Access to technology has become the number one driver to accelerate ag producers into the future, and today's rural areas experience increased productivity due to the adoption of new technologies that are fueling U.S. agricultural growth.

However, many producers still lack access to basic Internet and broadband technologies, and that leaves them at a competitive disadvantage. While we cannot be data rich, we seem to be information poor, and it's important that we provide our ag producers and our leading innovators like Lindsay the connectivity and the tools that they need.

Mr. Hassinger, can you please expand on the broader picture of when farmers are not able to access broadband, such as planting and productivity, and how does this lack of connectivity affect when you have machine operations or machine to farm operations?

Mr. HASSINGER. Well, thank you, Senator Fischer, and I would describe your summary as well said in terms of the challenge in front of us. Just to bring a little more context to it, a recent USDA report indicates that just under 30 percent of the farms across our rural country do not have access to broadband capability. So when you look at that—and I'll just use the technology that Lindsay has brought forward called Field Net Advisor, which is simply a pivot control tool that allows science-based recommendations to the irri-

gation. Our trials would say that that is generating roughly an additional $40 per acre, to put that in—again, more information.

On corn trials, that was a 3 percent yield. It was reducing the trips over the field. It reduced the energy cost, which brought a $40 per acre profit. But, equally important, it reduced the amount of water used per acre by 17 percent. Senator Fischer, what that says is roughly 30 percent of our farmers are not getting access to that type of technology. So that's a competitive disadvantage for them, and this is a space where increasing investment is being made, and you would anticipate that divide would only get wider over time.

Senator FISCHER. You know, when we look at the connectivity that's available for broadband, especially mobile broadband, what kind of metrics do you think we need to consider when we address that network? A lot of times, we look at road miles. Don't you think we ought to look at acres?

Mr. HASSINGER. Well, I think absolutely. The——

Senator FISCHER. Especially in sparsely populated areas?

Mr. HASSINGER. Without a doubt. You know, here, I'm mentioning that roughly 30 percent of the farms that don't have access. The more critical metric, as you said, would be the amount of acres that are not covered related to that. I put this—I think something that's very powerful on this is at a time when we know—and there's a lot of talk about the need to increase food production—irrigated acres represent roughly 16 percent of the total acres, but they represent 44 percent of the total output. So making sure that those acres, as you mentioned, Senator Fischer, have access to the newest technology becomes only even more important as we go forward.

Senator FISCHER. Thank you, sir.

Thank you, Mr. Chairman, for your courtesy.

Senator WICKER. Thank you, Senator Fischer.

Senator Schatz.

Senator SCHATZ. Thank you, Mr. Chairman. Thank you to all of the testifiers.

Ms. Siefer, I have a question for you about the two rulemakings that are happening at the FCC. The first is to change the form, and I think there's some support for that. I wanted to get your comments on that.

But the second is to redefine what broadband is, and I want to make sure the Committee understands what the FCC is doing. They're redefining broadband from 25 down, 3 up—please nod if I'm getting that right—yes—25 down, 3 up, to 10 down, 1 up. So what they're doing is just—they're going to redefine broadband so that they can declare that more people have broadband now. But all they're doing is playing with words as opposed to helping people to get access to broadband.

I'm wondering if you can comment on both of those rulemakings, Ms. Siefer.

Ms. SIEFER. Senator Schatz, I'll be happy to. The change in the speed is really significant for IoT. If anything, IoT means we're going to need more speeds, not less speeds. The issue related to the 25–3 down to 10–1 is inclusion of mobile in that definition. But mobile comes with data caps. As mentioned earlier, mobile is not a solution, at least not currently, until we could not have data caps.

Ask any farmer if data caps are useful, right, and they'll be very frustrated with the question.

Senator SCHATZ. Is there any community of users of IoT or broadband that is pushing for this change from 25–3 to 10–1? I'm just wondering who's asking for this change? Why is this change being made?

Mr. Adcock, I wanted to, first of all, thank you for everything you've done on——

Senator WICKER. Does anyone wish to volunteer to answer that question?

Mr. TERZICH. Senator, I was just going to add I'm not aware of anyone that's asking for that, specifically. Quite frankly, it's a bit illogical, given the density and the information exchange requirements on a go-forward basis.

Mr. HASSINGER. I would just add that I share the same view. From a farming community, I'm not aware of any push for reclassifications, as you mentioned.

Senator SCHATZ. Anybody else?

[No verbal response.]

Senator SCHATZ. Mr. Adcock, my favorite topic—telehealth. We've been working together with Senator Cochran's staff and you and the University of Hawaii, and we're making good progress. Just a big picture question: What should the Congress—I know we worked together on amending the statute to allow Medicare to reimburse for telehealth services, and that's for another committee to consider. But what, in terms of the deployment of broadband, do you think is the next step that either the FCC or this committee should undertake?

Mr. ADCOCK. Thank you very much, and it has been a pleasure to work with you and different Members of Congress to try to advance telehealth. We have great need in Mississippi. I know that there's great need across the country. I would say that the deployment of broadband is extremely important.

While there are things that we can do—remote patient monitoring—there are things that we can do that don't require video, constant video. As the technologies advance and as the adoption increases with physicians and providers across the country, there's going to be more and more done in a patient's home, including video visits. While that's happening now, it's not happening with a great spread across the country.

So we need to be able to have high-speed Internet in a patient's home that's reliable. It's not just about getting the capabilities there. It's about making sure that it's reliable and available. You can have as much connectivity into the home as you want. If it's not available at the time that it's needed, it's not going to help the patient. So we have to be able to have that priority of usage.

I think that the Rural Wireless Act and also the SPEED Act will help some of the deployment, to streamline review, accelerate deployment. Anytime that we can decrease the time that it takes to get the infrastructure out into these communities that have lower population density, that decreases cost and actually increases deployment, and being able to standardize that data reporting will help distribute funds to areas that are in need. So there's——

Senator SCHATZ. A quick final question for Mr. Terzich. Do you think there should be minimum security standards for IoT devices, and do you think that should be set in statute or rule, or do you think that should be done primarily by the private sector?

Mr. TERZICH. Well, you know, I'm not in a position to comment on the legislative side of that question. But I would offer the following. You know, for us, we're principally a B-to-B organization, and security is always a central part of the equation with our enterprise customers. I do believe, however, that at the consumer level, on the B-to-C side, that with the proliferation of interconnected devices, that some standardization should be applied, because I do see the consequential risk associated with broad proliferation of those devices across cloud-based computing capability.

Senator SCHATZ. Thank you very much.

Senator WICKER. I have next Senator Gardner followed by Senator Moran.

Senator Gardner.

STATEMENT OF HON. CORY GARDNER,
U.S. SENATOR FROM COLORADO

Senator GARDNER. Thank you, Mr. Chairman, and thank you for this hearing today. Thanks to all the witnesses and your statements this morning.

Thanks as well to Mr. Armitage, who joins us today from the great state of Colorado, where it's snowing a little bit, and we do, as a reminder to the Committee, have some ski resorts that are open right now.

[Laughter.]

Senator GARDNER. The Internet of Things is quickly transforming the way that we do business, go about our daily lives, and interact with our surroundings. As a member of the Internet of Things Working Group with Senators Fischer, Schatz, and Booker, I had the opportunity to work to promote legislation like the DIGIT Act, which some have already spoken about today, to encourage public-private collaboration on IoT related issues and prepare for the exciting future that these products really do mean for us.

While we should continue expanding and encouraging development of IoT, we must also be mindful of the security concerns, as Senator Schatz has talked about, which is why Senator Warner and I introduced the IoT Cybersecurity Improvement Act of 2017. Smarter devices should contain smart advancements in secure technology, and the Federal Government should set the gold standard for basic cyber hygiene. I do think it's an important conversation that we have, and Senator Schatz stumbled upon the question when he talked about setting the standards at the Federal level versus having that driven by the private sector, perhaps guided by a Federal procurement process.

One warning that this body has to consider is when Congress tries to set a standard and define the technology. We have to be careful that the technology doesn't evolve to a point where it backfires on us. A perfect example being in Colorado, where we created a criminal statute on Internet luring of a child using a Blackberry, and a judge determined that a Blackberry did not have the computing capability to be defined as a computer, and, therefore, the

statute was no longer able to be applied in that instance. The case had to be dropped because we tried to define a technology, and a judge thought that we didn't actually get it right.

We have to be very careful when we're defining technology in a statute, and that's why the approach that we've taken is sort of a procurement level process that tries to drive private sector innovation. I'm excited that we have a group of individuals here today that can explain the benefits of IoT to our communities, and I look forward to having many more conversations with you.

Mr. Armitage, you mentioned in your testimony the need for connectivity along with routes that your oil and gas company partners travel on a daily basis. You also talk about efforts to enhance that connectivity through partnerships and collaboration with the wireless industry. Could you talk a little bit more about this point? Obviously, Ms. Siefer talked a little bit about the challenges between mobile wireless issues and broadband availability. Do you view the business need for IoT in rural areas as a catalyst for expanding rural broadband and connectivity? I guess it's kind of a chicken and the egg kind of question, so to speak.

Mr. ARMITAGE. Mr. Hassinger brings up a very important notion that we should be really evaluating, at least in the context of the industrial IoT, which is the availability of broadband connectivity in a per-acre as opposed to per-road network. When we look at the coverage on the Nation's road networks and around the population centers, it's stunning. But when we look at the coverage available out in remote and rural areas off of those roads, it's pretty dead out there.

There's no question that the work this committee can do to encourage and enhance the private sector to push more and more coverage and more and more bandwidth into those areas is critically important to the viability of agriculture, the economic prosperity of the energy industry, and many, many other sectors.

One thing that I think is interesting to consider is that the FCC should be encouraged, in my opinion, to open up more frequency, more bandwidth spectrum to push more wireless coverage into these remote areas. It's not always economically viable to string wires and pull fiber into remote fields, but it is absolutely true that enhanced high-speed cellular networks will serve as a catalyst for everything that this group up here is talking about today.

Senator GARDNER. Thank you, Mr. Armitage. I know Senator Hassan and I are working on legislation that would make more spectrum available across the country, and it would also take a unique approach that I hope this committee takes very seriously. When we raise the funds through the auction that this spectrum would require, it would take about a 10 percent chunk of that and set the money raised through that spectrum auction, and make it available for rural broadband deployment. I think that could be a significant benefit for this closing of the digital divide that we've talked about and the challenges we face.

I can guarantee you that while the cellular phone map shows that south of Yuma, Colorado, there is cell coverage between Yuma and Joes, Colorado, by the time you hit Smith Dairy into Abarr, Colorado, and you go down to Joes and Kirk, you do not have cell coverage. I know that means absolutely nothing to anybody here.

However, for those of us who look at a map and say we should have coverage, it means a whole lot.

Mr. Hassinger, you and I may be the only people in this room, particularly, maybe even in this Congress, who have made a living selling farm equipment. We have a Zimmatic sprinkler on our farm north of town. We sell Case IH farm equipment. We started out with our first—I guess we sold a subscription, a satellite subscription, for a GPS system, and then we moved from that to try to use the Coast Guard beacons. We're too far away from the Coast Guard beacons in eastern Colorado to use them, so we now have our own signal.

You know, you're not going to be able to run a sprinkler some day when you manually change the drop nozzles, or the drip nozzles, on a sprinkler if you're going to have an IoT device applying individual amounts of chemigation to an individual plant. You're going to have to have broadband capability to do that. I'm running out of time. It's exciting stuff, and we've got a lot of work to do.

Mr. HASSINGER. I would echo exactly what you said.

Senator WICKER. Thank you, Senator Gardner. Senator Schatz wanted to point out that in Hawaii, it's currently 85 degrees.

[Laughter.]

Senator WICKER. There is some mountain in Hawaii that has snow.

Senator SCHATZ. I'm sorry—75. The sun is not out yet.

Senator GARDNER. The skiing in Haleakala is just not that good.

[Laughter.]

Senator WICKER. Senator Moran.

STATEMENT OF HON. JERRY MORAN,
U.S. SENATOR FROM KANSAS

Senator MORAN. Kansans are always delighted when there's snow in Colorado, assuming that the water will then come to our state.

Let me start with Mr. Hassinger. A bit of follow-up to Senator Gardner. You said in your commentary that 30 percent of our farms are not getting that technology. Is that a Nebraska statistic? Based upon this conversation we're having about how we determine who has broadband and who doesn't, how does one reach that conclusion or that specific number?

Mr. HASSINGER. Senator, first of all, to the earlier comment, that's a definition as it was described as 25 down and 3 up, from that standpoint. Let me give you the specific source. It is from USDA. Specifically, the National Agricultural Statistics Service released its Farm Computer Usage and Ownership Report in August, and that's where that data is coming from. Just slightly under 30 percent of the farms do not have that access, under the definition that I just described.

Senator MORAN. It didn't lend itself to a definition of farms, which is an agriculture question. I see your equipment in Kansas a lot. I'm familiar with Lindsay Corporation. I would highlight for my colleagues on the Committee that our Subcommittee on Consumer Protection and Data Security will have a hearing next Tuesday, November the fourteenth, to focus on data usage practices specifically for farms and innovative opportunities to improve yield,

sustainability, and interconnection among our rural farmers. We're continuing this conversation.

I wanted to ask you, Mr. Hassinger. What is the most prominent challenging barriers to successfully connecting rural communities and farms to high-speed broadband? What are the programs? In the FCC, we would have Universal Service Fund; USDA, we'd have Rural Development dollars. What is it that the Federal Government is not doing that Congress needs to do?

Mr. HASSINGER. Senator, I feel very comfortable representing where the value and the opportunity is in front of us. I'm going to have to pause and say that my expertise and knowledge in terms of how to exactly solve it is still further behind, from that standpoint. So what I really want to reinforce is the value that I can see through the technology that companies like ours is bringing and the need for it. But I'll have to pause on answering specifically your question.

Senator MORAN. Let me also ask you a question about something you said. Are 16 percent of the acres that are irrigated represent 44 percent of the yields? Is that a Nebraska or is that a national statistic?

Mr. HASSINGER. No, that's a national number also.

Senator MORAN. Thank you very much.

Let me ask you a question, Ms. Siefer. In regard to veterans' issues, what you described with your father is very compelling. I understand the value of that circumstance. What role did the VA play in your father's capability to access that technology, if any?

Ms. SIEFER. Right. So the VA's role was to bring him the device, and then I hooked it up, and that was 5 years ago. So the VA today—I would hope—frankly, they're not very communicative—maybe that will change shortly—about their broadband efforts. But I would encourage them to have efforts where they are making sure that the individuals that they're working with do have access at home, not just for the health reasons, the health IoT, but jobs and economy and everything else.

Senator MORAN. Ms. Siefer or Mr. Adcock, do you have any understanding of the differences between the private sector and the VA in regard to what they're doing to provide in-home healthcare through technology? Is the private sector ahead of the VA?

Mr. Adcock, any sense of that?

Mr. ADCOCK. I would say that the VA is a leader in telehealth, obviously. I can tell you about our program. We actually—when we're doing remote patient monitoring, we go in and check the cell signal in the home where it's going to be used to make sure that it's going to qualify for being able to utilize the equipment. So we make sure that that cellular service is available by utilizing the local providers and the regional providers in our state.

And if, for some reason, it's not available, we work to try to see if there's a wired option available. If that's not available, we talk to the service providers and let them know where there are coverage lapses so that we can look down the road to be able to enhance that coverage. I will tell you that because of remote patient monitoring not needing as much of the high speed, we're able to deliver that service in more areas throughout the state.

Senator MORAN. When you say more areas—Mr. Hassinger and I talked about the 30 percent of acres not—the broadband, the technology, not available. What's your experience for when this service is not available to patients who need it because of lack of service?

Mr. ADCOCK. For remote patient monitoring, again, it can run on a 3G connection, so there are very few patients that we've come across, probably less than 1 percent, that cannot—that we can't use our remote patient monitoring solution on. Now, if you start talking about being able to do video visits into the home, which is coming, we're going to run into a lot more issues, a lot more connectivity issues in the homes. Right now, we're able to meet most of those issues, whether it's in the home or in the school, wherever it might need to be.

Senator MORAN. Do you have a sense of what percentage would be unable to have video?

Mr. ADCOCK. I do not at this point, but that's something I can look at and get back to you.

Senator MORAN. Thanks to all the panelists for your testimony.

Senator WICKER. Thank you, Senator Moran.

Senator Klobuchar.

STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM MINNESOTA

Senator KLOBUCHAR. Thank you very much, Mr. Chairman.

I'm one of the co-chairs of the Broadband Caucus. We've been working really hard, especially to try to get infrastructure funding in any kind of an infrastructure bill that could come across our desk. I know that the President pledged to make infrastructure a priority, and we think rural broadband should be a major part of that.

So, Mr. Hassinger, I was just in Winnebago, Minnesota, on Friday and saw a company called Aker Ag, and they're doing some incredible work with drones and looking at being able to get soil samples out, and then being able to figure out in a better way for the environment, but also a more cost-effective way for our farmers—former Congressman Tim Penny was with me there. He's helped—his foundation has helped fund some of this operation. It just made me think about—this is all going to be great, but if they don't have broadband to get the data, to report it back to the companies that are supplying these farmers, it's not going to work.

So could you talk about this precision ag that we're heading into now and how important it's going to be to have real-time data updates and reliable service for our farmers?

Mr. HASSINGER. Well, Senator, I'll go back and hit the key points that I said earlier, and, again, I'm just using one example, the Field Net Advisor. But a $40 per acre profit—on average, is what we're seeing—is a significant difference, and only to your point, the investment is increasing there, so you would expect that divide to get greater as we go forward. I think it's a fundamental competitiveness that, longer term, is going to be a significant challenge if these farms that are not having access to this broadband capability—it's going to really put them at a disadvantage.

Senator KLOBUCHAR. Exactly. And I think there is also—for a lot of my friends on the Committee that are focused on environmental issues as well, there is a major advantage to that for where they put pesticides, or how much water they put in, if they're able to measure that soil to make it better, and they can't do that if they don't have that information.

Mr. HASSINGER. Absolutely. And, Senator, I would just add that at a time when farms are getting bigger, and the need for managing those larger acreages, this type of technology only becomes even more important also.

Senator KLOBUCHAR. OK. Very good.

I introduced the Measuring the Economic Impact of Broadband bill, including—I think Senators Capito and Sullivan worked with me on that, and this focuses on a study out of the Department of Commerce to conduct an analysis of the effects of broadband deployment and adoption on the U.S. economy.

Ms. Siefer, how would that be helpful for organizations like the National Digital Inclusion Alliance to reduce this divide?

Ms. SIEFER. Having that data would help us convince funders, frankly, because that's the big challenge right now. A lot of folks will say, "Yes, we definitely need broadband. We need folks who know how to use it." But then when you turn to figuring out who it is that's going to pay for it, that's a little more challenging, because they want the end numbers. They want to know did someone get a job. So that study could help that argument in making sure that we do have adequate funding for the programs.

Senator KLOBUCHAR. Maybe it'll help here, around this building, too.

Mr. Adcock, recently, Senators Roberts and Moran and I led a letter with 39 Senators urging the FCC to continue advancing broadband deployment in rural communities through the USF fund, the Universal Service Fund, and we've seen some progress, but not enough. Could you talk about the Universal Service Fund, how that's helped in Mississippi, and have you seen price disparities for broadband service between rural and urban areas?

Mr. ADCOCK. Thank you very much. Yes, we have been active in the Universal Service Fund for quite a while, where we—we've based ourselves in the hub to lots of the other sites across the state, and it's allowed us to not only build infrastructure, but also decrease the cost of that wireless that's—I mean, the broadband that's available to those institutions. I do not have an exact dollar figure of how much those funds have helped, but it has been a great program that we continue to be interested in. As far as the disparities in rural versus urban, I do not have the answer to that question.

Senator KLOBUCHAR. Well, I think we have to modernize the Universal Service Fund. Some work has been done at the FCC, but not enough——

Mr. ADCOCK. Right.

Senator KLOBUCHAR—and there's a ton of money in there, and then we have these rural areas that basically—while they now have Internet, they don't have the kind of Internet in many places in my state that's going to allow them to compete, as was just pointed out.

I will leave my question on Chairman Wicker's Rural Wireless Access Act for the record. I don't want to go over my time. But I'm a co-sponsor of that bill and it's very important. So thank you.

Senator WICKER. And thank you, Senator Klobuchar.

Senator Hassan.

STATEMENT OF HON. MAGGIE HASSAN,
U.S. SENATOR FROM NEW HAMPSHIRE

Senator HASSAN. Thank you, Mr. Chairman.

Good morning to all of our witnesses. Thank you so much for being here this morning, and thank you for shining a light on the importance of this so-called Internet of Things to rural communities. It is clear from your testimony that the Internet of Things will bring major positive changes all across our country, and I'm certainly eager to see the benefits to our society and our economy.

Coming from a state with many rural areas that New Hampshire has, I am also very concerned about the broadband issue, that last mile issue, and I wanted to take the opportunity—if you all don't know it and if my colleagues don't know it—Commissioner Rosenworcel on the FCC has an e-mail address, *broadbandfail@fcc.gov,* where people can report in their lack of broadband access, because she thinks it's about time, as do I, that we crowdsource this rather than waiting on the census block maps which are so inaccurate. So I would encourage constituencies everywhere to report in whether they've got broadband or not in certain areas.

Toward that end—no, it's not just broadband. It's obviously access and availability of spectrum that is going to be so important as we deploy more and more of the IoT. So I joined with my friend, Senator Gardner, to introduce the AIRWAVES Act, which aims not only to get some funding for rural broadband, but also to free up more spectrum. The legislation creates a pipeline of spectrum so that industry has something to rely on as we move forward.

So I'd love your comments to the Committee on the importance of the availability of spectrum for IoT as well as the importance of having an abundant supply of both licensed and unlicensed spectrum for these devices to function. We can start with Mr. Adcock and just work right down the line.

Mr. ADCOCK. I don't have an answer to that at this point. I'm sorry.

Senator HASSAN. That's fine.

Mr. Armitage.

Mr. ARMITAGE. We currently process at Cartasite over 3,000 events per second from 34 countries. I can tell you that in the United States, more than 10 percent of the workers' time is spent outside of coverage areas—10 percent. This is an enormous amount of our country that is currently not covered by spectrum, by any cellular coverage at all. We don't see it when we drive down the nation's highways. We absolutely see it when we drive in these rural areas of the U.S. So we can provide some very interesting insight as to where that coverage is lacking right now.

Senator HASSAN. Thank you.

Mr. Hassinger.

Mr. HASSINGER. Senator, I don't have anything further to add.

Senator HASSAN. OK. Thank you.

Mr. TERZICH. Senator, I would just make a simple statement that says both across spectrum and broadband, in general, that for our business, for our enterprise customers, it's, quite frankly, table stakes. You absolutely can't enable some of the business, the B-to-B benefit. You can't enable the exchange of real-time information without having this capability.

Senator HASSAN. Thank you.

Ms. Siefer.

[No verbal response.]

Senator HASSAN. Well, then, the other thing I wanted to just explore a little further with all of you is concerning cybersecurity. It's estimated that 8.4 billion things will be used this year alone, which opens up a lot of risk, and as you probably all know, in New Hampshire, a company named Dyn, Inc., knows all too well how this risk translates into a devastating cyber attack. In late 2016, Dyn was subjected to a major cyber attack in which the attackers co-opted baby monitors and other Internet connected devices infected with malware, and that flooded the servers of this Internet hosting company. The attack led to dozens of major retailers and media sites being taken offline for several hours, causing an unknown amount of loss of revenue for those companies.

So if we're going to prevent the ability of hackers to disrupt our economy and the flow of information, we're going to have to take action to try to raise the cyber defenses of consumers' Internet connected devices. I join Senator Warner and Senator Gardner's legislation on the Internet of Things Cybersecurity Act, and as we have discussed, that really is focused on requirements for things that the government purchases. But I would be interested in your thoughts on how we can enhance cybersecurity in the entire Internet of Things market. What's your approach to cybersecurity, and how should the Federal Government work with the private sector to ensure devices are secure?

Ms. Siefer, I'll start with you, and I realize we're short on time. So just quick answers, if you can.

Ms. SIEFER. Just to make sure everyone realizes that the cybersecurity issues also influence broadband adoption, because if you are scared, right, because you don't trust the Internet of Things, you're not going to use the Internet of Things.

Senator HASSAN. Thank you.

Anyone else, just briefly?

Mr. Hassinger.

Mr. HASSINGER. The only thing I would add, Senator, to broaden your question is the actual ownership of the data.

Senator HASSAN. Yes.

Mr. HASSINGER. Speaking of our situation, the customer owns the data, and then our responsibility is only to collect it, store it, and transfer it. So the broader part of that is the security, but also the ownership of the data.

Senator HASSAN. Thank you.

Anyone else?

Mr. ADCOCK. Obviously, being in healthcare, security is always a concern. It's something that we pay a lot of attention to and make sure that we encrypt data on both ends, both in transit and

at rest. But, again, if the patients aren't comfortable with that cybersecurity and what steps we're taking, they're not going to use it.

Senator HASSAN. Thank you.

Thank you very much, Mr. Chair, for letting me go over.

Senator WICKER. Thank you, Senator Hassan.

Senator Cortez Masto.

STATEMENT OF HON. CATHERINE CORTEZ MASTO, U.S. SENATOR FROM NEVADA

Senator CORTEZ MASTO. Thank you, Mr. Chair, and thank you for this discussion. It's one we have been having and rightfully so. I'm from Nevada—110,000 square miles of the five largest counties across the country. We have two of them in Nevada with small populations. And when we're talking about rural Nevada, and you want to get off the grid, drive through rural Nevada. You literally cannot connect.

That's the challenge. That's the challenge for many people that live in rural parts of our state, and that's why I, along with my colleagues, have been fighting to bring broadband and connectivity to our rural communities for the very reasons that we're talking about. Telemedicine is key. There's so many services that we can bring to our rural communities that are challenged.

But I'd like to start also with Mr. Hassinger. Obviously, some of the agriculture in Nebraska is a little different than that in Nevada. But you hit on a similar concern, and that's water. Can you speak further about the opportunity of improving the precision of measuring drought or measuring possible conditions to predict wildfires?

Mr. HASSINGER. So, Senator, what I was referring to—and, again, the tool I'll highlight is referred to as Field Net Advisor. What this is is there has been technology for several years that help determine the center pivots, the irrigation equipment. But now we're moving to a level of being able to align that with recommendations based on soil conditions, the weather, the specific genetics of that crop. What we're seeing is not only are we getting an increase in yield by use of that technology, but you're using less water. Simply, you're putting it right where the plant needs it with only the amount that it needs.

In the example that we have, the trials, we were able to get an increase in yield with 17 percent less water. So the conservation of water is obviously critical for the whole agricultural story, and we see this being a key driver in what we're talking about and the need for the adoption of this type of technology.

Senator CORTEZ MASTO. Thank you.

Mr. Terzich, I appreciate the various applications you underscored in your testimony. Can you talk to me about examples of where the Internet of Things is benefiting tourism, mainly in rural areas, for example, the hospitality sector or the outdoor economy?

Mr. TERZICH. I can. You know, for us in the hospitality space, it's become a growing area of interest. I can point to some specific examples. They may not necessarily be as relevant to Nevada as they are to other places. Mr. Young had left. But in the state of Colorado, we use a variety of real-time locationing tags that principally

go on every skier that attends any of the Vail resorts in Colorado. So it enhances your hospitality experience. It tells you the vertical feet you skied, the miles you skied, which runs you did, and people share that information, post their experience on social media, as an example.

In the cruise and transportation industry, you're seeing more use of passenger identification for applications as simple as mustering or simply as we're leaving a certain port. A cruise ship is leaving a port. It has to know within an instant moment that everyone is available, is back on that ship as planned. If something happens in transit, they want to know if somebody has left the ship, as examples.

In areas of theme parks, there are lots of use of Internet of Things to adjust the traffic at various attractions. So they actually look at dynamic work flow in the form of which attractions have a large volume of people. They use lots of technology, fast pass technology, things you may hear of in the public domain, to basically do better crowd management so that you enhance your experience and get the opportunity to see more attractions through the course of your day.

Senator CORTEZ MASTO. So in our rural communities, where there's hiking and rock climbing and mountain biking, literally, in areas that are remote, it's important to bring that sort of broadband there to have that security kind of connectivity for individuals that, unfortunately, may experience some sort of injury or something. We want to make sure we track people and be able to help them and access them immediately if there's some sort of injury.

Mr. TERZICH. Absolutely, the ability to respond to a critical situation, and I would venture to guess that for hikers and outdoor enthusiasts, the same interest applies, right? They want to know where they went, how many vertical feet they climbed, or how many trails they encountered. So you get the ancillary benefit of some social response as well as the ability to handle critical situations.

Senator CORTEZ MASTO. Thank you.

Any other comments?

[No verbal response.]

Senator CORTEZ MASTO. I notice my time is up. I've got other questions, but I'll submit those for the record.

Thank you.

Senator WICKER. Thank you, Senator Cortez Masto.

Senator Cantwell.

STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON

Senator CANTWELL. Thank you, Mr. Chairman, and I thank the witnesses.

Mr. Armitage, thank you for your testimony. I look at it with great interest because I think that you described well what happens as technology comes to any sector. I always say around here—I try to explain the transitioning economy and say to my young colleagues, the people in my office, there's a reason Ma Bell doesn't

exist anymore, and they look at me and they say "Who's Ma Bell?" because they don't know.

[Laughter.]

Senator CANTWELL. So I'd say that we've gone through this major transition of a big behemoth in telecomm to now this data we get in our handheld devices every day. So your testimony talks about that, particularly as it relates to the workforce and the impact on the workforce. Yet I'm assuming you believe that the efficiencies are still worth—driving efficiencies to be competitive in your sector, and I'm assuming that you want to be rewarded for those, not penalized for those. By that, I mean there are some people who are discussing, you know, letting people waive environmental issues just to—so that they'll drill in certain areas, and I think you've been a state that's adhered to all the environmental issues. So my guess is you wouldn't want to be waiving those. That's not really the subject of my question, but if you want to comment on that, you can.

Mr. ARMITAGE. Let me just touch on that point. My experience in the last 35 years working in the oil and gas industry is that the executives that I know are extraordinarily concerned about the safety of their workers and about the social responsibility of operating in an environmentally conscientious way, very committed to environmental stewardship, consistently across the board throughout the industry.

Senator CANTWELL. Right. So on the larger cyber issues, since we're seeing all these attacks by state actors, if you will, on critical infrastructure, everything from the networks of nuclear power plants to pipelines. I mean, we don't want to see the Ukraine situation here in the U.S. What do you think we should be doing to further our cybersecurity?

Mr. ARMITAGE. It is a subject that confronts us literally every day. It is an incredibly important issue, and we should bring it to light and talk about it extensively. Our servers get hit by bad actors literally multiple times a day. We're deployed, I believe, now in 34 countries. Many of those countries are not friendly to the United States. We have American workers and millions of dollars of assets that we monitor for U.S. companies throughout the world, and as a result, we are tested continuously. We've worked very closely for the last 11 years with Amazon and with Google and many other cloud providers to ensure the integrity of our systems, both from the perspective of security and availability.

So I will tell you that this is an issue near and dear to my heart. Mr. Adcock mentioned before the notion of encrypting on both sides of the transaction—vitally important. It's one of a myriad of issues that we should be paying attention to as we consider the industrial Internet of Things.

Senator CANTWELL. Well, thank you for that. I know that—to me, I believe that there's much efficiency in what you've done with your business and in smart buildings and everything else. But we do have to get more serious about the cybersecurity issues as a nation, and, as you said, some of this is state actors, acting with malice against our country. So I hope we can up our game here, and I look forward to following up with you on that in collaboration. Thank you.

Thank you, Mr. Chairman.
Senator WICKER. Thank you.
Senator Udall.

STATEMENT OF HON. TOM UDALL,
U.S. SENATOR FROM NEW MEXICO

Senator UDALL. Thank you so much, Senator Wicker, for this hearing and the importance of what you all have testified to today.

The application of the Internet of Things to rural America is absolutely critical, and I think your testimony has demonstrated that. I worry that unless we act aggressively and with purpose now, rural America will be stuck with the Internet of nothing. This is particularly true for my home state of New Mexico, where Internet services, connections, and applications lag way behind.

Each one of us know that rural areas do not have the same coverage and access as urban areas. To catch up, we must invest in high-speed broadband networks as well as other technology to connect the hardest to serve areas. And while I appreciate my colleague's efforts to help ease permitting and other hurdles, what companies need is sustainable, reliable funding and investment.

The FCC's Universal Service Fund programs are essential to connecting all areas of the country. But I'm concerned with the current direction of some of these programs. For example, the Rural Healthcare Program has been capped at $400 million since its inception, even now, as that demand has been growing every year. This year, providers in New Mexico have been adversely impacted due to the unilateral actions of the program administrator, denying requests for funding because there is not enough funding. This is not sustainable for rural healthcare providers, and it's not fair to patients in rural communities.

New Mexico has successfully used the Rural Healthcare Program, and it has saved significant healthcare dollars. For example, Project Access, a partnership between the University of New Mexico and a rural hospital, has performed over 1,200 consults across the state, saving patients the expense of being transported hundreds of miles to our largest city, Albuquerque. This program alone is estimated to have saved rural New Mexico hospitals $12 million, which is obviously a very significant savings.

The high-cost fund and the Connect America Program support carriers providing service to rural areas, but too many rural carriers in New Mexico face both shrinking support from the FCC and increased costs. We must do better if we genuinely want the Internet of Things to be a reality for rural connectivity.

Mr. Adcock, has the University of Mississippi Medical Center received support from the Rural Healthcare Fund?

Mr. ADCOCK. We have, as the hub of several spokes, so yes, in the rural areas.

Senator UDALL. Do you think that fund should be increased to better support increased participation in the program?

Mr. ADCOCK. I think the more funds that are available, the more that we can spread our service.

Senator UDALL. And, Mr. Adcock, healthcare providers in New Mexico have expressed concern that the Universal Service Administrative Company requires them to enter into long-term contracts

with service providers without a guarantee of funding from the Rural Healthcare program. Do you have the same concern?

Mr. ADCOCK. I can't speak to that. I'll have to get back to you with that answer.

Senator UDALL. Are there any others that are familiar with that, the Universal——

[No verbal response.]

Senator UDALL. OK.

Mr. Terzich, I'm concerned about the cybersecurity and protection of information that could be transmitted in the event of a cybersecurity attack. Can you talk about the appropriate cyber hygiene procedures that should be in place to protect business and consumers?

Mr. TERZICH. Thank you, Senator. From a Zebra perspective, we principally deal with enterprise B-to-B business, and a big part of the planning and the rollout of IoT solutions is a conjoined effort between the enterprise customer and our organization. A lot of our devices, as similarly mentioned in some prior conversation—a lot of our devices are generating information that is transmitted, and analytical data is shared over the broadband infrastructure.

So, for us, it's imperative that we design, in cooperation with the enterprise customer, the appropriate security measures to prevent cybersecurity issues. We have some of the world's largest customers that have a very high degree of interest in this particular area.

On the consumer side, I do see and I do recognize the proliferation of IoT devices will result in more encroachment opportunities if there isn't some form of certification and/or regulation for some of those devices. We've seen too many examples now of devices that become a portal for some wrongdoing, and I do think that there has to be some more controls imparted on the device manufacturers as part of that network.

Senator UDALL. Thank you to all of you for your testimony.

Thank you, Mr. Chairman.

Senator WICKER. Thank you, Senator Udall.

Senator Duckworth.

STATEMENT OF HON. TAMMY DUCKWORTH, U.S. SENATOR FROM ILLINOIS

Senator DUCKWORTH. Thank you, Mr. Chairman.

I want to thank the Chair and Ranking Member for today's hearing, and I also want to thank our witnesses for participating in this very important conversation.

Today, in the 21st Century, approximately 1.1 million people in Illinois are without access to broadband, and 1.2 million people have access to only one wire provider, and another 368,000 don't even have wired Internet providers where they live. Frankly, we have children who can't do their homework because of the lack of access.

Mr. Terzich, it's such a pleasure to have you here today representing Zebra Technologies, headquartered in Lincolnshire. I understand that Zebra's work in the healthcare sector provides smartphone platforms that provide a network of healthcare facilities in the Midwest to facilitate faster, better information sharing, and also response to individual patient care.

I know you've talked a little bit about the logistics part of your work, but I'd love to focus a little bit more on the healthcare side. About an hour south of where you're located is Edward Hines, Jr., VA Hospital, where I go to get my healthcare. It's operating a virtual ICU that provides continuous monitoring of veterans receiving ICU care throughout the entire region. They also offer outpatient care to satellite clinics, including six CBOC community-based outpatient clinics, via telehealth equipment so these patients don't have to be located in the Chicagoland area. They can be anywhere in Illinois, Manteno, or any place like that.

Can you discuss how Zebra's smartphone platforms work and how this type of technology can provide more efficient and better quality government services, such as by our VA hospitals?

Mr. TERZICH. Thank you, Senator, for the question. The healthcare segment—for the record, the healthcare segment for our business is the fastest growing segment that we have in our business. It has principally been driven off of the fact that, by and large, the healthcare value chain, if you will—supply chain, value chain—is still one of the most inefficient, error-fraught value chain that there is in the marketplace. So healthcare providers, both at the VA level and at the private sector, have been turning to more IoT-based solutioning.

The challenges of healthcare are many. The patient safety initiative has been a very viable one. We use a lot of our mobile computing IoT solutions to do a positive patient bedside application of medicine to avoid catastrophic errors or misapplication of meds so it improves the patient safety initiative.

There's a critical need in healthcare across the network of finding available equipment. It's no longer sufficient to know where equipment exists in a hospital. You need to know that that equipment is staged and ready to be applied. So hospitals are using dynamic workflow to get better utilization out of equipment, ensuring the right equipment is in the right surgical centers at the right time.

Mr. Adcock had mentioned earlier there is a growing—we see a growing interest by the private sector and by the VA to push more healthcare to the home. That's principally based on a number of reasons. There's a drive for better patient satisfaction, but there's also a significant push to lower the cost of healthcare, which is a challenge in and of itself here in the United States.

Senator DUCKWORTH. Thank you. Can you talk a little bit also about other potential applications in healthcare that maybe are more future-based, beyond just where you are now? As you said, it's a growing sector. It can bring down healthcare costs. But I just think of the myriad of applications, for example, for patients in rural communities who can't get to a large hospital and being able to direct them to the kind of care that they need or to get the care to them.

Mr. TERZICH. The home healthcare space is growing. The satellite network care application is growing as well. So hospitals are forming smaller satellite locations where the exchange of information—they bridge some of the distance that patients have to travel in order to get some form of in-hospital healthcare—is a growing area.

You had mentioned earlier the Edward Hines Hospital. We're doing a lot of work now, a lot of exploratory work, where they are optimizing the workflow of a surgical center. The idea of turning the surgical center over more frequently is no different than turning airplanes off of a gate more quickly. You have high-priced equipment, you have high-priced caregivers, and how do they stage equipment, stage the surgical teams in an appropriate way to move more patients through, increase patient safety, get greater utilization of assets.

Senator DUCKWORTH. Thank you so much.

I yield back.

Senator WICKER. Thank you, Senator Duckworth.

Mr. Adcock, in your testimony, you say that mobile broadband has worked for the remote patient monitoring pilot program, but, quote, "as telehealth grows and additional services are available in the home, a more flexible fixed solution will be necessary." What do you mean by that and why?

Mr. ADCOCK. I think that some of the issues that we run into with mobile technology—and thank you for the question. Some of the issues that we've run into with mobile technology is around the type of materials homes are built around. So if you have a tin roof, if you have a tin mobile home, we have some issues with signal getting in from a cellular standpoint. So being able to have access to different reliable means that aren't affected by the type of home, aren't affected by weather, aren't affected by line of sight, is extremely important to us.

As we connect with patients across the state and the telehealth grows across the country, we need to be able to get—we need to be able to deliver healthcare where and when you need it, and the only way to do that is to have reliable service, whether that's fixed service, whether that's mobile service, that is more reliable and more available and faster. Any and all of those are important to us as we try to deliver healthcare.

Senator WICKER. Well, how realistic is that? Wouldn't more reliable mobile be a little more realistic than fixed, in terms of actually our ability to get it done?

Mr. ADCOCK. In patients' homes, absolutely, for sure.

Senator WICKER. Let me ask you, Ms. Siefer. A number of us have stressed the Universal Service Fund. In my opening statement, I said the FCC needs to take steps to ensure that this provides adequate and predictable support. At the current rate, where are we going to be 5 years from now or even 10 years from now, at the current rate of deployment of broadband coverage?

Ms. SIEFER. So the current rate is too slow, in terms of the deployment itself and the speed of what it is they're deploying. So if you look at the different Federal programs, they're not all 25–3. Some of them are 10–1. So we're putting Federal money into new infrastructure that's only 10–1.

Senator WICKER. OK. Well, help us out here. Is this a measurement?

Ms. SIEFER. Correct.

Senator WICKER. A measurement of coverage, which is technical and which we understand a little bit about. You said that—in your

testimony, you said that 39 percent of rural Americans lack access to broadband service, and that's if you measure it at——

Ms. SIEFER. At 25–3.

Senator WICKER.—at 25 up and 3 down.

Ms. SIEFER. Yes, sir.

Senator WICKER. Now, as I understand it, that's going to change to 25 down and 1 up? Is that right?

Ms. SIEFER. The current recommendation of the FCC is to change it, but it has not changed yet.

Senator WICKER. If that changes, what would that 39 percent become? I guess it would be a better looking figure.

Ms. SIEFER. It's a better looking figure, but it hasn't changed anybody's life, no.

Senator WICKER. Well, let me ask the rest of you. At the current rate, are we expanding service at any rate that's going to get us where we need to be 5 years from now, 10 years from now? Would anybody like to comment on that?

Mr. Armitage.

Mr. ARMITAGE. On the wireless side, absolutely. On the wired side, probably less so. This is very dependent upon the availability of wireless spectrum, but our ability to deploy new wireless technologies that deliver high speed to remote areas is extraordinary. There are two new technologies coming out right now, this year, called LTE, NB, and LTE Cat M1, which are transforming the industrial Internet of Things and bringing connectivity to remote areas through the existing LTE network, that, frankly, is the most important thing probably that's happened in the last 10 years, in my experience in the industrial IoT space. So the world is changing quickly on the wireless side.

Senator WICKER. I believe you had a recommendation in your testimony, Mr. Armitage, that incentives need to change. Would you explain what you meant by that?

Mr. ARMITAGE. I don't believe that was in my testimony. I believe the oil and gas industry has every incentive in the world, driven by low commodity prices, to reduce operating expenses, and that they are acting quickly to streamline their business process and leveraging industrial IoT to do it.

Senator WICKER. All right. Thank you.

I think we now go back to Senator Markey.

Senator Markey, you are recognized.

STATEMENT OF HON. EDWARD MARKEY,
U.S. SENATOR FROM MASSACHUSETTS

Senator MARKEY. Thank you, Mr. Chairman, very much.

The Internet of Things could also be considered the Internet of Threats. It has a dual personality, and it is absolutely essential that we provide protections for appropriate cybersecurity and data security to be built into these devices. As many as 50 billion IoT devices are projected to be in our pockets and homes by the year 2020. Cybersecurity will continue to pose a direct threat to economic prosperity, privacy, and our Nation's security. That's why I introduced the Cyber Shield Act, which would create a voluntary cybersecurity certification program for IoT devices.

The Cyber Shield Act will establish an advisory committee of cybersecurity experts from academia, industry, consumer advocacy communities, and the public to create cybersecurity benchmarks for IoT devices, such as baby monitors, cameras, cell phones, laptops, and tablets. The IoT manufacturers can then voluntarily certify that their products meet those industry standards, the leading cybersecurity and data security benchmarks, and display this certification to the public. The program will both reward manufacturers adhering to best practices and assure that consumers can reliably identify the most secure products.

For each witness, do you believe that a program like this will help to improve our devices' cybersecurity?

Mr. Adcock.

Mr. ADCOCK. Again, I think that with the programs that we're using, we make sure that the data is encrypted. But, yes, anything that we can do to increase the security standards would be greatly appreciated from a healthcare standpoint.

Senator MARKEY. Great.

Mr. Armitage.

Mr. ARMITAGE. In a word, no.

Senator MARKEY. Please explain.

Mr. ARMITAGE. The pace of sophistication of the bad actors is extraordinarily fast, probably can outstrip any regulatory standards that we could put in place, and, in fact, those well defined standards may provide a bull's eye for the bad actors rather than the objective, which is to provide a shield. So I would suggest that, at least in the industrial sector, the industries have tremendous incentive to secure all ends of every piece of telemetry, and they are doing that aggressively, and, literally, week by week, month by month, they are evolving their sophistication.

Senator MARKEY. Of course, the problem is not the ones who are doing it. The problem is the ones who aren't doing it. That's the problem. So by giving a special status to those who are doing it, it essentially is saying to consumers, it's saying to the world, well, here's a whole crowd over here that's changing this thing, and they're not spending the money, and that could be half of all of the entities that we're talking about.

Mr. ARMITAGE. And I don't focus on the consumer space, in all fairness. I focus strictly on B-to-B. So in the business space, those companies will not be selling products for very long if they don't secure their products.

Senator MARKEY. Right. They won't be, but the public should know. They can see it on a car. They can see it on energy star. They can see, you know, what gets a good rating and what doesn't, so you could vie for the rating, at least, to say for this past year they were in the ball park. But it doesn't last forever, an energy star rating. But you don't see any merit in that at all, Mr. Armitage?

Mr. ARMITAGE. I think the challenge is that standards are evolving——

Senator MARKEY. I appreciate that. I'm not saying it lasts forever, but for the duration of time that we establish it, you've got it, you know, and if you don't keep it up, then——

Mr. ARMITAGE. I absolutely hear you, and I support the notion of creating standards, as long as we understand that they're very transient.

Senator MARKEY. Right, but they're very transient in every area. It's like—if you have no standards, then the only person that ultimately gets hung is the consumer. They don't know anything. They're just assuming that some CEO that's trying to squeeze out a few extra bucks for their pocket, you know, and they don't want to spend the money on improving their security is actually concerned about them when it's only crocodile tears that are coming out of their eyes. So we want them to adopt an RSA standard. We want them to adopt a top standard.

Mr. Hassinger, I'm going to run out of time here. What do you think?

Mr. HASSINGER. I sure acknowledge that there is a need for standards. Specifically to the Shield Act, I can't speak to it. I would need to come back to you with——

Senator MARKEY. But the concept of having some information out there that people can rely upon?

Mr. HASSINGER. I support that standards are set, as I say. To go further than that, I actually need to come back to you with more of a thorough response.

Senator MARKEY. Right.

Mr. Terzich, the industry participant, we just voluntarily put up that they're actually complying with the standard. What do you think?

Mr. TERZICH. I think in the B-to-C space, it would certainly be additive and helpful. It would deter, but not prevent, as we know. I think there will be and there is an expectation of a proliferation of devices on a go-forward basis, and there are other complicating factors associated with deterrence, including, for the consumer, the home network in and of itself and other forces and other factors.

Senator MARKEY. One of the standards would be that as the security evolves that it improves over time with patches, that that company is going to be patching as they see it, and that's the standard they're going to adopt. What do you think about that?

Ms. SIEFER. I would just ask that within that, there also be the education of the consumer so that they understand how to use it.

Senator MARKEY. But how about if you're meeting the standard, that you make it—you're allowed to make it public, and that you're going to be updating.

Ms. SIEFER. Yes, because, as we know, if folks aren't comfortable—if they think that their data is going to be stolen, if anything is going to be stolen from them, if they're scared, they're not going to participate in the IoT.

Senator MARKEY. I got you.

Thank you, Mr. Chairman.

Senator WICKER. Thank you.

Let me just ask Ms. Siefer this about the Commission's Form 477 data collection process. Can you share your views on how the Form 477 data collection process can be modernized to improve our understanding of where broadband coverage is not adequate to support IoT technologies?

Ms. SIEFER. We need to know who has broadband and where. Currently, the Form 477—if a provider is serving one individual in a census block, that census block is good, which we all know is particularly problematic in rural areas, because if you have a large census block and one person has coverage, we're getting an inaccurate picture.

So we need to narrow it down much smaller than a census block, and we also need to know the speeds at which—because right now, they have these very unusual, doesn't kind of make sense, blocks of speeds. But rather, we need to be able to look at what speeds are actually being offered by the providers and know that that's what's available in those areas.

The one extra thing that nobody wants to talk about is cost. It's not part of Form 477 discussions, generally, because the providers are really uncomfortable sharing what they are charging the consumer. So a bigger issue that's kind of out there, that's probably not going to be addressed by Form 477, is that we need to know what the cost of broadband is for the consumer.

Senator WICKER. Does the Form 477 answer your census block concern?

Ms. SIEFER. Not currently, no.

Senator WICKER. So you think that needs to be fixed?

Ms. SIEFER. And that is one that is very fixable.

Senator WICKER. How do we fix that?

Ms. SIEFER. The providers need to be telling us at a smaller level and/or more accurately. We cannot say that it's OK that they tell us a census block—that they have coverage in that census block if only one person has coverage.

Senator WICKER. Who's going to decide how narrowly to divide those blocks up?

Ms. SIEFER. The FCC has the authority to decide that.

Senator WICKER. On this 25 down and 3 up and 10 down and 1 up measure of broadband speeds, what broadband speeds does one need to currently operate IoT technologies?

Ms. SIEFER. So that's a hugely—the answer varies massively by the technology and by the individual who's using the technology. So, as mentioned earlier, as video becomes more common within the health industry, and we are then wanting that patient in their home to use that video with their health providers, 10–1 is insufficient, but we're not at a point where everybody needs video, currently. But we all shouldn't be making decisions about what our situation is now. We as a country need to be planning for the future.

Senator WICKER. Does anyone else want to engage in the issue about what speeds are adequate now in terms of operating IoT technologies?

[No verbal response.]

Senator WICKER. No volunteers? One other thing.

Ms. Siefer, you say we don't currently have a program to address cost. What do you advocate?

Ms. SIEFER. So we don't currently have data that tells us what it costs for someone to have broadband in their home. If you even do a quick online search, what you'll be able to find is an introductory price from a provider at that particular address, and you

might be able to find what their regular cost is. And, sometimes, if you call the provider, they'll tell you what the regular cost is. But they don't always, and you can't go online right now and find a map that tells us if it's more expensive here, it's least expensive here, and these are the different price points. So that is something that would need to be legislated. That is not—the FCC is never going to tell the providers——

Senator WICKER. Do they have the authority?

Ms. SIEFER. They have the authority, but I don't know that they have the political interest.

Senator WICKER. So administration in and administration out, Democrat, Republican?

Ms. SIEFER. No, none of them.

Senator WICKER. They have not done so. Would you advocate legislation?

Ms. SIEFER. It would have to be legislation.

Senator WICKER. Does anyone wish to take issue with that?

[No verbal response.]

Senator WICKER. Well, thank you all for your testimony. I think it has raised a lot of questions that need to be looked at, but I think we're considerably better off having had your testimony, and thank you for working with us and spending the time.

Now, I have to make an announcement before we close. I would like to enter into the record a letter from the Competitive Carriers Association, which underscores the importance of expanding high-speed, reliable Internet connectivity to rural areas to advance the Internet of Things in these communities. We'll do that without objection.

[The letter referred to follows:]

COMPETITIVE CARRIERS ASSOCIATION
November 7, 2017

Hon. ROGER WICKER, Chairman,
Subcommittee on Communications, Technology, Innovation, and the Internet,
U.S. Senate Committee on Commerce, Science, and Transportation,
Washington, DC.

Hon. BRIAN SCHATZ, Ranking Member,
Subcommittee on Communications, Technology, Innovation, and the Internet,
U.S. Senate Committee on Commerce, Science, and Transportation
Washington, DC.

Dear Chairman Wicker and Ranking Member Schatz:

Competitive Carriers Association (CCA) commends the Subcommittee for holding today's hearing on the use and benefits of the Internet of Things (IoT) in rural areas and respectfully asks that this letter be added to the hearing record. CCA's members serve many rural and remote parts of our country and understand how providing mobile broadband services in these areas is fundamental to providing consumers, businesses, public safety officials, health professionals, farmers and others with the latest advances in IoT. It is important to note, however, the innovations discussed at today's hearing will not be possible without robust network connectivity. Coverage and access to a network are the beginnings of all things IoT.

IoT is transforming every sector of America: healthcare, education, finance, agriculture, transportation, public safety and commerce. In fact, rural Americans stand to benefit most from these revolutionary innovations, and are today early adopters of the latest technologies. New innovations will help support continued investment in networks in rural areas as business models built on a "river of pennies" approach aggregate scale economies from thousands of new connections. However, this future is far from certain, and absent policy decisions to preserve and expand mobile broadband in rural America, the future of IoT in rural areas will be limited.

Universal Service

Congress created the Universal Service Fund to support reasonably comparable services in urban and rural areas. In today's increasingly connected world, those services must include ubiquitous mobile broadband services. With the support of bipartisan and steadfast leadership from this Committee, the Federal Communications Commission (FCC) is moving forward with Phase II of the Mobility Fund. Importantly, the FCC is collecting updated and more reliable mobile coverage data to determine eligible areas based on a map that should more closely resemble consumers' on-the-ground experiences. CCA appreciates this Committee's support and ongoing oversight of Mobility Fund II as it is implemented to preserve and expand mobile services today and lays the foundation for the future of 5G. Next generation networks will power untold innovations and are key to unleashing IoT technologies in rural areas, and Congress should continue work to ensure that the high cost areas connected through USF support, combined with private investments, become and remain served.

Streamlining Deployment

Today, the mobile broadband infrastructure deployment process is fraught with unnecessary hurdles and delays that frustrate deployments and increase costs across the country. To support expanded IoT connections, Congress should champion policies that promote investment and streamline unnecessary hurdles through increased certainty regarding the facility siting process and timelines for application review. Siting is particularly challenging when seeking to deploy on Federal lands and facilities, where deployment is often necessary to serve rural areas. CCA supports legislative efforts to streamline the process and provide increased certainty, including the bipartisan "Streamlining Permitting to Enable Efficient Deployment of Broadband Infrastructure Act of 2017" or the "SPEED Act" (S. 1988), as well as the Senate-passed "Making Opportunities Available for Mobile Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless Act" or the "MOBILE NOW" Act (S. 19). Advancing and enacting these and other legislative efforts will promote mobile broadband deployment to keep pace with IoT proliferation.

Spectrum

Consumers have become accustomed to ubiquitous service even as increasingly the "last mile" technology is wireless. In addition to physical infrastructure, mobile broadband depends on the invisible airwaves that carry ever-growing amounts of data. Access to finite spectrum resources, including in rural America, is critical to keeping up with consumers' insatiable demand for data services and will be further strained as carriers work to deploy 5G next-generation technologies. These services, including IoT, require competitive carriers to have access to low-, mid-, and high-band spectrum. As the Federal government is the largest holder of spectrum, incentivizing opportunities to reallocate Federal spectrum for commercial mobile use will help support exponentially growing uses. Legislative initiatives such as the bipartisan "Advancing Innovation and Widespread Access to Viable Electromagnetic Spectrum Act" or the "AIRWAVES Act" (S. 1682) facilitate greater spectrum access while also supporting deployment in unserved and underserved areas using a portion of auction proceeds to expand services.

Mobile networks are a key economic driver, and connecting Americans through new IoT technologies and innovations has the potential to improve quality of life for every citizen. Policymakers must ensure rural consumers are not left behind. CCA thanks the Subcommittee for its leadership on these important issues, and looks forward to continued engagement. We welcome any questions or comments on this timely topic.

Sincerely,

STEVEN K. BERRY,
President and CEO.

CC: The Honorable John Thune, Chairman, Committee on Commerce, Science, and Transportation
The Honorable Bill Nelson, Ranking Member, Committee on Commerce, Science, and Transportation

Senator WICKER. The hearing record will remain open for two weeks. During this time, Senators are asked to submit any questions for the record. Upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible, with all deliberate speed.

If anyone has any reason why we should not conclude the hearing, speak now or forever hold your peace.

[No verbal response.]

Senator WICKER. The hearing is now adjourned, and we thank the witnesses.

[Whereupon, at 11:46 a.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF HON. BILL NELSON, U.S. SENATOR FROM FLORIDA

Thank you, Mr. Chairman, for holding this hearing. The Internet of Things has great potential to keep American industry competitive and productive and to keep Americans healthy.

I am looking forward to learning about the latest technological developments and what they are doing for rural America. But I am also aware that the Internet of Things cannot reach its full potential without robust Internet connectivity.

We also need to remember that the promise of the Internet of Things must be balanced with real concerns about privacy and the security of our networks. We should all work together to make sure the great potential of the Internet of Things does not fall victim to a lack of foresight and protections for these systems and the consumers and industries that will come to rely on them in the future.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. TOM UDALL TO MICHAEL TERZICH

Question. During our discussion in Committee, you stated that customers of your company, typically enterprise customers, will work with you to provide the particular cybersecurity needs. Is there a list of common requests you receive from the enterprise customers?

Answer. Zebra has an internal cross-functional Information Security Council that works with Zebra customers to answer questions about our security architecture. Zebra's Information Security Council membership includes technical, legal and business leaders that respond to specific product security questions.

Customers typically want to confirm that Zebra has formal policies and standards covering information asset restrictions, information asset classification and management, cryptographic controls, access controls, legal and regulatory compliance programs, operations and data systems security and facility security. Zebra provides assurances regarding the regular testing of key controls, systems, policies and procedures related to our security programs.

In addition, customers often request a review of the Service Organization Control 2 (SOC2) report for Zebra's production data centers which documents various organizational controls related to security, availability and processing integrity.

Finally, customers also seek confirmation that Zebra has appropriate access controls, administrative and technical measures to maintain the confidentiality of Customer's data including any Personally Identifiable Information (PII).

The following are common high-level requests received from enterprise customers:

- Details on Zebra's use of encryption technologies.
- How physical-layer security is implemented in products.
- Details on the methods Zebra deploys for real-time detection and prevention of security-related incidents.
- Details on Zebra's compliance with international data privacy regulations.
- Specific information on policies related to the regular auditing of security controls. Examples of actual questions from customers by subject matter:

Network Security

- Describe your network architecture.
- What is your firewall infrastructure?
- Is the network monitored 24/7?
- Is there proper security testing procedures to network infrastructure?
- Is your network properly secured (two step authentication, secure gateway, restricted network access etc.)?

- What are password standards?
- Have you implemented commercial software solutions that address virus/malware related issue?
- How is remote access to your network monitored and protected?
- Are appropriate user account restrictions in place to only allow employees to access information needed to complete their job duties?
- What mechanisms are in place to log, store and review all significant activity?
- Are server builds standardized and hardened to a level appropriate to the environment in which they operate?
- What procedures are in place for remaining up to date with system and security fixes, performing adequate testing and applying to production servers?
- Do you adhere to industry standards?
- Do you comply with applicable laws and regulations related to security and privacy?
- Does Zebra maintain insurance that covers security incidents?

Data Handling

- How do you handle storage/transmission/use of personal information?
- How is one customer's data isolated from the data of other customers?
- Are databases encrypted?
- Where applicable, is Zebra PCI compliant?

Backup/Disaster Recovery Plan

- How do you ensure ongoing service in the event that a system fails?
- What is your incident response procedure?
  - Are all incidents logged?

Managing Threats & Vulnerabilities

- How do you ensure that security measures are up to date?
- How are system patch and vulnerability identification managed?
- Are internal audits of information security systems present?
- Will customer information be stored outside of U.S.?
- Is third party network access restricted?
- Are third party security assessments performed?

Personnel Access Security

- How are security policies communicated within the organization?
- How are confidentiality and security responsibilities addressed with employees, vendors, and consultants?
- Are pre-employment background checks performed?
- Are individuals subject to disciplinary action for violation of security requirements?
- Are staff only allowed to access the minimum amount of confidential information required to fulfill their job?
- Is there a security awareness program and is it included in employee training?
- What is required to access these applications (ID, Password, Token)?

System Management

- How is security administered on Zebra systems?
- Does Zebra employ methods to detect and prevent malicious and/or accidental changes?

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